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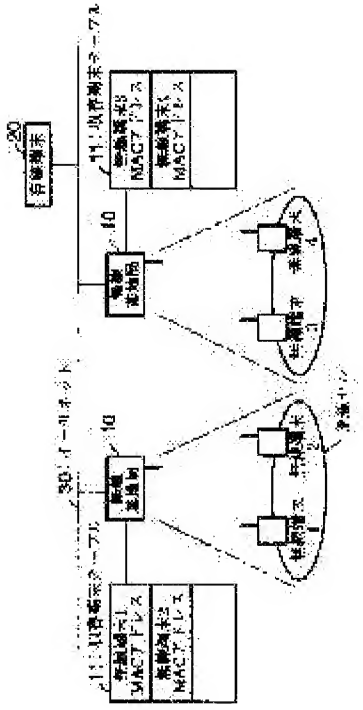
(54) RADIO PACKET TRANSFER METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a radio packet transfer method by which possibility of packet transfer by a direct transfer method resulting in failure is low and packet transfer by the direct transfer method is conducted so long as it is possible.
SOLUTION: In this radio packet transfer method, only radio terminals by which packet transfer by the direct transfer method is successful with a high possibility are registered in a direct transfer table based on a reception state or the like of a packet sent from radio terminals 1-4 toward optional radio terminals and received by its own station. Only the registered radio terminals are object of application by the direct transfer method and a relay transfer method via a radio base station 10 is applied to the other radio terminals.



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CLAIMS

[Claim(s)]
[Claim 1]When a radio terminal addresses to other radio terminals and transmits a packet, the concerned transmitting former radio terminal transmits a packet to a base transceiver station, A relay transfer method that the base transceiver station concerned transmits the packet concerned to the address radio terminal concerned, Or the concerned transmitting former radio terminal chooses either of transfer-direct methods which transmit the packet concerned to the address radio terminal concerned directly, Transmit the packet concerned by a selected method, said address radio terminal and said base transceiver station transmit, when said packet is received without an error, and a reply signal a said transmitting former radio terminal, When said reply signal is received within after-transmission fixed time of said packet, it is judged as packet transmission completion, In a radio packet transfer method which judges it as packet transmission non completion, and resends the packet concerned in not receiving said reply signal within after-transmission fixed time of said packet, said radio terminal, a. memorizing a transfer-direct table which specifies a radio terminal which can apply said transfer-direct method -- b. -- transmitting a packet by said relay transfer method, when the address radio terminal concerned is not registered into said transfer-direct table, and, when transmitting a packet to other arbitrary addressing to a radio terminal, When the address radio terminal concerned is registered into said transfer-direct table, a packet is transmitted by said transfer-direct method, c. Based on a receiving condition in a local station of a packet transmitted to arbitrary addressing to a radio terminal, It is judged whether a registration condition for a transmitting agency radio terminal of the packet concerned to be registered into said transfer-direct table is fulfilled, When fulfilling the registration condition concerned, the concerned transmitting former radio terminal is registered into said transfer-direct table, d. At least based on one side of a receiving condition when a local station receives a packet which transmitted to the addressing to a radio terminal concerned from a transmission result or arbitrary radio terminals when a local station transmits a packet to addressing to a radio terminal registered into said transfer-direct table, A radio packet transfer method erasing registration of the radio terminal concerned in said transfer-direct table when judging whether registration cancellation conditions for erasing registration of the radio terminal concerned in said transfer-direct table are fulfilled and fulfilling the registration cancellation conditions concerned.
[Claim 2]Said radio terminal is a receiving level beyond threshold L1 in the same transmitting agency radio terminal about a packet transmitted to arbitrary addressing to a radio terminal, The radio packet transfer method according to claim 1 judging with that by which a radio terminal which is the transmitting origin fulfills said registration condition, and registering the radio

terminal concerned into said transfer-direct table when it receives once [continuation m].
[Claim 3]Said radio terminal is a receiving level beyond threshold L1 in the concerned transmitting former radio terminal about a packet transmitted to arbitrary addressing to a radio terminal, The radio packet transfer method according to claim 1 judging with that by which a radio terminal which is the transmitting origin fulfills said registration condition, and registering the radio terminal concerned into said transfer-direct table when it receives once [in P 1 time / Q] (P1>=Q1).
[Claim 4]Said radio terminal is a receiving level beyond threshold L1 in the same transmitting agency radio terminal about a packet transmitted to arbitrary addressing to a radio terminal, The radio packet transfer method according to claim 1 judging with that by which a radio terminal which is the transmitting origin fulfills said registration condition, and registering the radio terminal concerned into said transfer-direct table continuation m1 time or when it receives once [in P 1 time / Q] (P1>=Q1).
[Claim 5]Said radio terminal transmits a packet by said transfer-direct method, and with the same transmitting agency radio terminal Continuation m2 time, A radio packet transfer method given in any 1 claim of claims 1-4 judging with that by which a radio terminal which is the address fulfills said registration cancellation conditions, and erasing registration of the radio terminal concerned in said transfer-direct table when it is judged as packet transmission non completion.
[Claim 6]Said radio terminal transmits a packet by said transfer-direct method, and among P 2 times with the same transmitting agency radio terminal Q2 time (P2>=Q2), A radio packet transfer method given in any 1 claim of claims 1-4 judging with that by which a radio terminal which is the address fulfills said registration cancellation conditions, and erasing registration of the radio terminal concerned in said transfer-direct table when it is judged as packet transmission non completion.
[Claim 7]Said radio terminal transmits a packet by said transfer-direct method, and among continuation m2 time, or P 2 times with the same transmitting agency radio terminal Q2 time (P2>=Q2), A radio packet transfer method given in any 1 claim of claims 1-4 judging with that by which a radio terminal which is the address fulfills said registration cancellation conditions, and erasing registration of the radio terminal concerned in said transfer-direct table when it is judged as packet transmission non completion.
[Claim 8]Said radio terminal is a receiving level below threshold L2 in the same transmitting agency radio terminal about a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal, A radio packet transfer method given in any 1 claim of claims 1-7 judging with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions, and erasing registration of the radio terminal concerned in said transfer-direct table when it receives continuation m 3 times.
[Claim 9]Said radio terminal is a receiving level below threshold L2 in the same transmitting agency radio terminal about a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal, A radio packet transfer method given in any 1 claim of claims 1-7 judging with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions, and erasing registration of the radio terminal concerned in said transfer-direct table when it receives Q 3 times in P 3 times (P3>=Q3).
[Claim 10]Said radio terminal is a receiving level below threshold L2 in the same transmitting agency radio terminal about a packet which a radio terminal registered into said transfer-direct

table transmitted to arbitrary addressing to a radio terminal, Continuation m3 time or when it receives Q 3 times in P 3 times (P3>=Q3), it judges with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions, A radio packet transfer method given in any 1 claim of claims 1-7 erasing registration of the radio terminal concerned in said transfer-direct table.

[Claim 11]Said radio terminal does not receive a packet which a radio terminal registered into fixed time and said transfer-direct table transmitted to arbitrary addressing to a radio terminal, And when 1 time does not have transmitting a packet to the registered radio terminal concerned, and becoming packet transmission completion, either, A radio packet transfer method given in any 1 claim of claims 1-10 the registered radio terminal concerned fulfilling said registration cancellation conditions, and erasing registration of the radio terminal concerned in said transfer-direct table.

[Claim 12]Said radio terminal notifies beforehand starting of a receiver, starting of said receiver in a power save mode which repeats a stop periodically, and a cycle of a stop to said base transceiver station, To said power save mode from an active mode which maintains said receiver during communication with activation status. Or in performing a change to said active mode from said power save mode conversely, it notifies a mode change to said base transceiver station, When transmitting a packet to other addressing to a radio terminal and the address radio terminal concerned is in said power save mode, A radio packet transfer method given in any 1 claim of claims 1-11 transmitting the packet concerned by said relay transfer method irrespective of whether the address radio terminal concerned is registered into said transfer-direct table.

[Claim 13]a time of said radio terminal transmitting a packet to other radio terminals -- being concerned -- others, in attesting between radio terminals and not succeeding in attestation, being concerned -- others -- irrespective of [whether a radio terminal is registered into said transfer-direct table] -- said relay transfer method -- being concerned -- others -- a radio packet transfer method given in any 1 claim of claims 1-12 performing packet transfer to a radio terminal.

[Claim 14]A radio packet transfer method given in any 1 claim of claims 1-13 when said radio terminal's transmitting a packet by broadcasting, wherein it transmits the packet concerned by said relay transfer method.

[Claim 15]It is detected whether said radio terminal is located in within the circle [of a service area of said base transceiver station], or it is located outside the circle, A radio packet transfer method given in any 1 claim of claims 1-14 transmitting a packet by said transfer-direct method when located in the outside of the circle of a service area of said base transceiver station.

[Claim 16]A radio packet transfer method given in any 1 claim of claims 1-15, wherein said radio terminal erases registration of all the radio terminals in said transfer-direct table with a change of a base transceiver station which is an in-zone state place.

[Claim 17]When a base transceiver station and two or more radio terminals perform wireless packet communication, a radio terminal transmits a packet and packet length of the packet concerned exceeds a fragmentation threshold set up beforehand, In a radio packet transfer method which divides the packet concerned and transmits so that packet length may become below in said fragmentation threshold, said radio terminal, When packet transfer by a relay transfer method that transmit a packet to said base transceiver station, and the base transceiver station concerned transmits the packet concerned to an address radio terminal is performed, A radio packet transfer method using a separate fragmentation threshold respectively by a case where packet transfer by a transfer-direct method which transmits the packet concerned to the address radio terminal concerned directly is performed.

[Claim 18]When a base transceiver station and two or more radio terminals perform wireless packet communication, a radio terminal transmits a packet and packet length of the packet concerned exceeds an RTS threshold set up beforehand, Give an identifier and said packet length of a local station to an RTS signal, transmit to an address radio terminal or said base transceiver station, and said address radio terminal or said base transceiver station, In permitting transmission of said packet by a transmitting agency radio terminal of said RTS signal, A radio terminal which gave and transmitted to a CTS signal respectively by having made into a permission address and a reservation period an identifier and packet length which were given to the RTS signal concerned, and transmitted an RTS signal, Said packet is transmitted when a CTS signal which includes an address of a local station as a permission address is received, In a radio packet transfer method which shelves transmission of an RTS signal and a packet until a period equivalent to a reservation period given to the CTS signal concerned expires, when a CTS signal which does not include an address of a local station as a permission address is received, When packet transfer by a relay transfer method that said radio terminal transmits a packet to said base transceiver station, and the base transceiver station concerned transmits the packet concerned to an address radio terminal is performed, A radio packet transfer method using a separate RTS threshold respectively by a case where packet transfer by a transfer-direct method which transmits the packet concerned to the address radio terminal concerned directly is performed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the radio packet transfer method in wireless packet communication.
[0002]
[Description of the Prior Art]Conventionally, this kind of radio packet transfer methods included the following.
[0003](1) Range LAN2 automatic-switching method Range LAN2 are the wireless LAN products of a 2.4GHz bandwidth. Packet transfer is performed in this Range LAN2, using selectively the transfer-direct method that the relay transfer method that a transmitting agency radio terminal transmits a packet to an address radio terminal via a base transceiver station, or a transmitting agency radio terminal transmits a packet to an address radio terminal directly. It is automatically changed by the transmitting agency radio terminal side any shall perform packet transfer between the relay transfer method and the transfer-direct method in this case. It is as follows when it furthermore explains in full detail.
[0004]The radio terminal of a transmitting agency carries out transfer direct of the packet concerned to the address radio terminal concerned by the transfer-direct method first, when the packet which should be transmitted to other addressing to a radio terminal arises. Then, a transmitting agency radio terminal resends a packet, when not receiving the reply signal from an address radio terminal within fixed time. And even if a transmitting agency radio terminal transmits a packet 3 times, when not receiving a reply signal, it changes the method of packet transfer for the address radio terminal concerned to the relay transfer method. Henceforth, a transmitting agency radio terminal changes again the method of packet transfer for the address radio terminal concerned to the transfer-direct method, when a packet is transmitted by the relay transfer method, fixed time continuation is carried out to the address radio terminal concerned

and packet transfer is not performed between the address radio terminals concerned.
[0005](2) Decision of the standards of wireless LAN is advanced in the fragmentation division transmission method IEEE802.11 committee. And the fragmentation division transmission method is supported in the standards proposal upon which it was decided in the committee. In this fragmentation division transmission method, when exceeding the threshold (fragmentation threshold) as which the packet concerned was beforehand determined when a radio terminal transmitted a packet, the packet concerned is divided and it transmits so that packet length may become below in this fragmentation threshold. As a reference relevant to this art, There is "IEEE P202.11,Draft Standard For Wireless LAN Medium Access Control(MAC) and Physical Layer (PHY) Specification, D6.1."
[0006](3) In the standards proposal of the wireless LAN upon which it was decided in the RTS/CTS random access method above-mentioned IEEE802.11 committee, the RTS/CTS random access method besides the above-mentioned fragmentation division transmission method is supported.
[0007]In this RTS/CTS random access method. When a radio terminal transmits a packet and the packet length of the packet concerned exceeds the threshold (RTS threshold) defined beforehand, The identifier (transmission source address) and packet length of a transmitting agency radio terminal are given to the RTS (Request To Send) signal for requiring a request to print out files of a radio channel, and it transmits to an address radio terminal or a base transceiver station.
[0008]If this RTS signal is received, in order to permit the reservation request of a radio channel and to report this to other radio terminals or base transceiver stations, an address radio terminal or a base transceiver station, The transmission source address of an RTS signal is made into a permission address, and it gives and transmits to a CTS (Clear To Send) signal by making packet length into a reservation period.
[0009]It is judged whether if this CTS signal is received, the permission address shown by a CTS signal and the address of the transmitting agency radio terminal which transmitted the RTS signal of the concerned transmitting former radio terminal correspond. And transmission of a packet and an RTS signal is not performed until a reservation period expires, when not in agreement [when both addresses are in agreement, a packet is transmitted, and].
[0010]after a receiver reports a request to print out files of a radio channel with a CTS signal according to this method, in order that the transmitting side may transmit a packet -- what is called -- it can hide and the problem of a terminal can be solved. As a reference about this method, "IEEE which already mentioned. There is P202.11,Draft Standard For Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, D6.1."
[0011]
[Problem(s) to be Solved by the Invention]By the way, the following problems were among each conventional technology mentioned above.
[0012](1) The problem of the Range LAN2 automatic-switching method [0013]** When two sets of the radio terminals which cannot perform transfer direct perform packet transfer, the increase in the time required until packet transfer is completed, and degradation of the throughput of the radio packet whole system arise.
[0014]For example, drawing 45 shows an example of the situation which such a problem produces. In the example shown in this drawing 45, the shelter S intervenes between the radio terminal a and the radio terminal b, and both cannot do transfer direct. In such a case, if it shall set, for example, the radio terminal a shall transmit a packet to radio terminal b in accordance with the Range LAN2 automatic-switching method, Since the radio terminal a will change to the

relay transfer method which went via the base transceiver station 10 after trying the packet transfer by the transfer-direct method 3 times, the time required until packet transfer is eventually successful will become long. Since three packet transfer is performed by the transfer-direct method, radio-channel resources are consumed vainly and the problem that the throughput of the radio packet whole system deteriorates arises. A base transceiver station produces each above problem also in the network composition connected to the cable packet network. In this case, the radio terminal which is in the service area of a base transceiver station cannot perform a wired terminal and transfer direct. However, if the Range LAN2 automatic-switching method shall be followed, Even in such a case, the problem of degradation of the increase in the time required of packet transfer and the throughput of the radio packet whole system produces it in order to perform the change to the relay transfer method, after a radio terminal tries transfer direct 3 times to a wired terminal.

[0015]** If the change to the relay transfer method from the transfer-direct method is once performed, even if an address radio terminal will move to the position in which transfer direct is possible for a transmitting agency radio terminal after that, Unless communication between a transmitting agency radio terminal and an address radio terminal stops continuously beyond fixed time, the change to the transfer-direct method is not performed. Therefore, the radio terminals in which transfer direct is originally possible will communicate vainly using a base transceiver station, and there is a problem of causing the increase in the packet transfer time by going via a base transceiver station and decline in the transfer efficiency by consumption of radio-channel resources.

[0016]** While the problem radio terminal relevant to a power save mode is operating by the power save mode which repeats starting and a stop of a receiver periodically, a packet may be transmitted to the addressing to a radio terminal concerned. When a packet is transmitted to the radio terminal concerned in the period which has a receiver of a radio terminal at a halt condition in this case, reception of a packet is not performed, but a radio channel is vainly consumed as a result, and there is a problem that degradation of the throughput of the radio packet whole system arises.

[0017]** When the problem Range LAN2 automatic-switching method relevant to attestation of the radio terminal shall be followed, it may happen that a radio terminal transmits a packet to other radio terminals which refused attestation by the transfer-direct method. In this case, since a packet will be discarded by the radio terminal side which refused attestation, a radio channel is vainly consumed as a result and there is a problem that degradation of the throughput of the radio packet whole system arises.

[0018]** Broadcasting which transmits the same packet all at once to the radio terminal of problem plurality in the case of broadcasting may be performed. If the above-mentioned Range LAN2 automatic-switching method shall be applied to the radio packet system by which this broadcasting is performed, Since the packet (broadcasting packet) which is an object of broadcasting will be first transmitted to each radio terminal by the transfer-direct method, The radio terminal which carries out the whereabouts to the position which cannot see and carry out transfer direct from a transmitting agency radio terminal has the problem that a broadcasting packet is unreceivable.

[0019]** A problem radio terminal in case the change of a base transceiver station arises may move, and the base transceiver station which is an in-zone state place may change. In this case, the radio terminal which was performing packet transfer by the transfer-direct method to a certain address radio terminal before movement will perform packet transfer by the transfer-

direct method to the same address radio terminal after movement. However, the packet transfer by the transfer-direct method may become difficult between address radio terminals by the change of a base transceiver station,In that case, transfer direct ends in failure, radio-channel resources are consumed vainly, and there is a problem that the throughput of the whole radio packet transfer system deteriorates. When the channel frequency used for communication with the change of a base transceiver station changes, When a packet is transmitted by the transfer-direct method with new channel frequency after a change to the address radio terminal which had transmitted the packet by the transfer-direct method before a change, it may end in failure. Also in this case, radio-channel resources are consumed vainly, and there is a problem that the throughput of the whole radio packet transfer system deteriorates.

[0020](2) The probability that a packet error will arise in a radio transmission line becomes high as packet length becomes long in radio packet transmission at the general problem of the fragmentation division transmission method. Since according to the fragmentation split method it transmits after dividing about the packet exceeding a fragmentation threshold so that packet length may become below a fragmentation threshold, this problem is solvable.

[0021]However, since a header is given to each packet after division when dividing a packet and transmitting, it becomes a factor in which a throughput deteriorates.

[0022]Therefore, in consideration of the error rate in the radio transmission line of the radio packet transfer system which serves as the object in applying the fragmentation division transmission method, when an error rate is large, a fragmentation threshold is made small, and when an error rate is small, to enlarge a fragmentation threshold is desired.

[0023]By the way, in a radio packet transfer system, a base transceiver station is installed in the position which can generally keep seeing Hitoshi Amai's radio terminal. On the other hand, a radio terminal is used in desk superiors and a chiefly low position. Therefore, the transmission line between radio terminals has a large error rate compared with the transmission line between a radio terminal and a base transceiver station.

[0024]Therefore, in the radio packet transfer system with which a radio terminal changes and uses the relay transfer method and the transfer-direct method, When a fragmentation threshold is made into a value suitable for the transmission line between a radio terminal and a base transceiver station, a packet error rate becomes large at the time of the packet transfer by the transfer-direct method, and there is a problem that a throughput falls. Conversely, when a fragmentation threshold is made into a value suitable for the transmission line between radio terminals, there is a problem that a throughput falls by the overhead by packet division at the time of the packet transfer by the relay transfer method.

[0025](3) since according to the problem RTS/CTS random access method of a RTS/CTS random access method a receiving station transmits a CTS signal and a request to print out files of a radio transmission line is declared -- what is called -- it can hide, a terminal problem can be solved and a throughput can be improved. However, in the case of this method, an RTS signal and a CTS signal need to be delivered and received, and the overhead by this causes throughput degradation.

[0026]Therefore, in applying a RTS/CTS random access method. The probability of hiding in the radio packet transfer system used as the object, and being generated by the terminal is taken into consideration, When the probability of making an RTS threshold small, hiding and preventing the influence by a terminal when the probability of hiding and being generated by the terminal is large, and hiding and being generated by the terminal is small, the overhead which enlarges an RTS threshold and is applied to transfer of an RTS signal and a CTS signal is controlled, and to

raise a throughput is desired.
[0027]By the way, as mentioned above, a base transceiver station is installed in the position which can generally keep seeing Hitoshi Amai's radio terminal, and a radio terminal is used in desk superiors and a chiefly low position. Therefore, the transmission line between radio terminals has the high probability that is easy to be influenced by a radio-shielding thing compared with the transmission line between a radio terminal and a base transceiver station, and will hide and a terminal will arise.
[0028]Therefore, in the radio packet transfer system with which a radio terminal changes and uses the relay transfer method and the transfer-direct method, When an RTS threshold is made into a value suitable for the transmission line between a radio terminal and a base transceiver station, it hides at the time of the packet transfer by the transfer-direct method, and becomes easy to produce a terminal, and there is a problem that a throughput falls. Conversely, when an RTS threshold is made into a value suitable for the transmission line between radio terminals, there is a problem that a throughput falls by the overhead which takes for transfer of an RTS signal and a CTS signal at the time of the packet transfer by the relay transfer method.
[0029]They are many problems which each conventional technology which the above mentioned above has.
[0030]This invention is made in view of the above situation, and that 1st purpose has a low possibility that the packet transfer by the transfer-direct method will end in failure, and there is in providing the radio packet transfer method which can perform that packet transfer according to the transfer-direct method as much as possible on the other hand.
[0031]The 2nd purpose of this invention solves the problem that it will not be received if packet transfer by the transfer-direct method is performed while the address radio terminal is operating by the power save mode, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.
[0032]The 3rd purpose of this invention solves the problem that it will be discarded by the address radio terminal side if an address radio terminal transmits a packet by the transfer-direct method when attestation is not successful, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.
[0033]When the 4th purpose of this invention transmits a broadcasting packet by the transfer-direct method, The radio terminal which has not carried out the whereabouts to the position in which transfer direct is possible solves the problem that a broadcasting packet is unreceivable, and it is in providing the radio packet transfer method which can transmit a broadcasting packet with high reliability.
[0034]In the case where the transmitting agency radio terminal to which the 5th purpose of this invention is performing packet transfer by the transfer-direct method to a certain address radio terminal changes a base transceiver station, If the concerned transmitting former radio terminal changes and packet transfer is performed by the transfer-direct method to the same address radio terminal as a front, transmission will solve the problem that it may end in failure, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.
[0035]The 6th purpose of this invention solves the problem of degradation of the improvement effect of the throughput at the time of applying a fragmentation split method, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet

transfer by the shortest possible packet transfer time.
[0036]The 7th purpose of this invention solves the problem of degradation of the improvement effect of the throughput at the time of applying a RTS/CTS random access method, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.
[0037]
[Means for Solving the Problem]It is aimed only at a high radio terminal by possibility that packet transfer by a transfer-direct method will be successful in order to attain the 1st purpose of the above, Packet transfer by a transfer-direct method is performed, and a means to except from an applied object of a transfer-direct method beforehand is desired about a radio terminal in which packet transfer by a transfer-direct method may fail.
[0038]Generally, since a radio terminal is what can move, even if transfer direct performed to an address radio terminal at a certain time is successful, when after that is another, transfer direct performed to the same address radio terminal is not necessarily successful. On the contrary, even if transfer direct performed to an address radio terminal at a certain time goes wrong, when after that is another, transfer direct performed to the same address radio terminal may be successful. That is, a radio terminal with a high possibility that packet transfer by a transfer-direct method will be successful was not fixed.
[0039]Therefore, when a possibility that packet transfer according [a certain radio terminal] to a transfer-direct method will be successful becomes a high radio terminal, this is promptly included in an applied object of a transfer-direct method, When a possibility that packet transfer according [a certain radio terminal] to a transfer-direct method will go wrong becomes a high radio terminal, a certain means to except this from an applied object of a transfer-direct method promptly is desired.
[0040]An invention concerning claim 1 is made according to such an idea, When a radio terminal addresses to other radio terminals and transmits a packet, the concerned transmitting former radio terminal transmits a packet to a base transceiver station, A relay transfer method that the base transceiver station concerned transmits the packet concerned to the address radio terminal concerned, Or the concerned transmitting former radio terminal chooses either of transfer-direct methods which transmit the packet concerned to the address radio terminal concerned directly, Transmit the packet concerned by a selected method, said address radio terminal and said base transceiver station transmit, when said packet is received without an error, and a reply signal a said transmitting former radio terminal, When said reply signal is received within after-transmission fixed time of said packet, it is judged as packet transmission completion, In a radio packet transfer method which judges it as packet transmission non completion, and resends the packet concerned in not receiving said reply signal within after-transmission fixed time of said packet, said radio terminal -- a. -- memorizing a transfer-direct table which specifies a radio terminal which can apply said transfer-direct method -- b., when transmitting a packet to other arbitrary addressing to a radio terminal, When the address radio terminal concerned is not registered into said transfer-direct table, a packet is transmitted by said relay transfer method, When the address radio terminal concerned is registered into said transfer-direct table, a packet is transmitted by said transfer-direct method, c. Based on a receiving condition in a local station of a packet transmitted to arbitrary addressing to a radio terminal, It is judged whether a registration condition for a transmitting agency radio terminal of the packet concerned to be registered into said transfer-direct table is fulfilled, When fulfilling the registration condition concerned, the concerned transmitting former radio terminal is registered

into said transfer-direct table, d. At least based on one side of a receiving condition when a local station receives a packet which transmitted to the addressing to a radio terminal concerned from a transmission result or arbitrary radio terminals when a local station transmits a packet to addressing to a radio terminal registered into said transfer-direct table, It judges whether registration cancellation conditions for erasing registration of the radio terminal concerned in said transfer-direct table are fulfilled, and when you fulfill the registration cancellation conditions concerned, let a radio packet transfer method erasing registration of the radio terminal concerned in said transfer-direct table be a gist.

[0041]According to this invention, only a high radio terminal of a possibility of succeeding when packet transfer by a transfer-direct method is performed can be registered into a transfer-direct table, and packet transfer by a transfer-direct method can be tried only for this registered radio terminal.

[0042]In this invention, it is judged based on "a receiving condition in a local station of a packet transmitted to arbitrary addressing to a radio terminal" in whether it is "a high radio terminal of a possibility of succeeding when packet transfer is performed" from the radio terminal concerned. That is, also when a receiving condition in a local station of a packet transmitted from a certain radio terminal is good, and a packet is transmitted to the radio terminal concerned by a transfer-direct method from a local station, at the radio terminal side concerned, reception of a packet should be performed by a good receiving condition. Then, when a receiving condition of a packet is good, it judges with a transmitting agency radio terminal of the packet concerned filling the above "registration condition", and it registers with a transfer-direct table.

[0043]About by what a "receiving condition" presupposes that it is good, although various standards can be considered, it is mentioned, for example that a receiving level of a packet is sufficiently large, that frequency where reception is performed with sufficient receiving level is high, that an error rate of received data is low, etc.

[0044]In this invention, a judgment of whether to register a certain radio terminal into a transfer-direct table is performed based on a receiving condition of "a packet transmitted to arbitrary addressing to a radio terminal" containing not only a packet addressed to a local station but other radio terminals. Therefore, according to this invention, when a certain radio terminal becomes what fills the above "registration condition", registration to a transfer-direct table can be performed at an early stage as much as possible.

[0045]There is once a case where a radio terminal registered into a transfer-direct table becomes less suitable as an applied object of a transfer-direct method, and, in this case, it is necessary to erase registration of the radio terminal concerned in a transfer-direct table by movement of a radio terminal etc. A judgment of whether to fill the above "registration cancellation conditions" serves as an opportunity of this registration cancellation, a receiving condition when a local station receives a packet which transmitted to the addressing to a radio terminal concerned from a transmission result or arbitrary radio terminals when this judgment transmits a packet to addressing to a radio terminal by which "local station was registered into said transfer-direct table -- at least -- on the other hand -- " -- it is carried out by being based.

[0046]In this invention, by performing procedure of registration and registration cancellation to the above transfer-direct tables at any time, A radio terminal with a high possibility of succeeding when packet transfer by a transfer-direct method is performed will always be registered into a transfer-direct table, and packet transfer by a transfer-direct method will be performed only for this registered radio terminal.

[0047]Therefore, according to this invention, a possibility that packet transfer by a transfer-direct

method will end in failure is low, the packet transfer according to a transfer-direct method as much as possible on the other hand can be performed, a high throughput is obtained and packet transfer can be performed by the shortest possible transfer time.
[0048]Now, as mentioned above, a judgment of whether to fulfill a "registration condition" based on a "receiving condition" can be performed by various kinds of methods, but the following methods are considered to be simplest and exact methods, for example.
[0049]** When it is a receiving level beyond threshold L1 and a packet transmitted to arbitrary addressing to a radio terminal is received once [continuation m] with the same transmitting agency radio terminal, judge a radio terminal to be that by which a radio terminal which is the transmitting origin fulfills said registration condition (claim 2).
** When the same transmitting agency radio terminal receives a packet transmitted to arbitrary addressing to a radio terminal once [in P 1 time / Q] (P1>=Q1) with a receiving level beyond threshold L1, judge with that by which a radio terminal which is the transmitting origin fulfills said registration condition (claim 3).
** Judge with that in which a radio terminal which is the transmitting origin in a receiving level beyond threshold L1 about a packet transmitted to arbitrary addressing to a radio terminal continuation m1 time or when it receives once [in P 1 time / Q] (P1>=Q1) fulfills said registration condition by the same transmitting agency radio terminal (claim 4).
[0050]By making the above-mentioned threshold L1 into a receiving level with which it is satisfied of a necessary packet error rate according to the describing [above] all directions method, When a local station transmits a packet by a transfer-direct method, only a radio terminal which can be transmitted by communication quality by which a necessary packet error rate is fulfilled can be registered into a transfer-direct table, and it can be considered as an applied object of a transfer-direct method.
[0051]Although a method of the above "a judgment of whether to fulfill registration cancellation conditions" can also consider various kinds of methods, the following are considered to be simple and exact methods, for example.
[0052]** When a packet is transmitted by said transfer-direct method and the same transmitting agency radio terminal judges it as packet transmission non completion continuation m2 time, judge with that by which a radio terminal which is the address fulfills said registration cancellation conditions (claim 5).
** When a packet is transmitted by said transfer-direct method and the same transmitting agency radio terminal judges it as packet transmission non completion Q2 time (P2>=Q2) among P 2 times, judge with that by which a radio terminal which is the address fulfills said registration cancellation conditions (claim 6).
** When a packet is transmitted by said transfer-direct method and the same transmitting agency radio terminal judges it as packet transmission non completion Q2 time (P2>=Q2) among continuation m2 time, or P 2 times, judge with that by which a radio terminal which is the address fulfills said registration cancellation conditions (claim 7).
[0053]** When the same transmitting agency radio terminal receives a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal continuation m 3 times with a receiving level below threshold L2, judge with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions (claim 8).
** The same transmitting agency radio terminal a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal with a receiving

level below threshold L2. When it receives Q 3 times in P 3 times (P3>=Q3), it judges with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions (claim 9).
** The same transmitting agency radio terminal a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal with a receiving level below threshold L2. Continuation m3 time or when it receives Q 3 times in P 3 times (P3>=Q3), it judges with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions (claim 10).
[0054]** A packet which a radio terminal registered into fixed time and said transfer-direct table transmitted to arbitrary addressing to a radio terminal is not received, And when 1 time does not have transmitting a packet to the registered radio terminal concerned, and becoming packet transmission completion, either, it judges with that by which the registered radio terminal concerned fulfills said registration cancellation conditions (claim 11).
[0055]It is as follows when an effect at the time of adopting the describing [above] all directions method is explained.
[0056]When transfer direct goes wrong, a possibility of failing even if it performs transfer direct to the address radio terminal same immediately after that is very high. According to the above-mentioned ** - **, a possibility that such transfer direct will go wrong can erase registration of a very high radio terminal, and it can except from an object of transfer direct.
[0057]When the above-mentioned ** - ** are adopted, the following characteristic effects are acquired by adjusting the threshold L1 used for a judgment of a registration condition, and the threshold L2 used for a judgment of registration cancellation conditions. First, when and a radio terminal registered into a transfer-direct table moves to a position by which necessary quality is not fulfilled at the time of transfer direct, by erasing registration and changing to a relay transfer method, communication quality can be maintained and a throughput can be raised. [L1=L] If [make L2 into a receiving level with which it is satisfied of a necessary packet error rate, and] L1>L2, change frequency of transfer direct and relay transfer can be controlled, and influence which it has on a radio terminal with a processing load accompanying a change can be inhibited.
[0058]Since registration in a transfer-direct table of a high radio terminal of a possibility that it is separated from a position in which transfer direct is possible in the distance is erased and it changes to relay transfer about the radio terminal concerned when the above-mentioned ** is adopted, useless packet transfer can be prevented and a throughput can be raised.
[0059]Each judgment method about registration cancellation conditions of having explained above may use together two or more kinds of things in order to raise accuracy of a judgment.
[0060]Next, an invention concerning claim 12 said radio terminal, Starting of a receiver, starting of said receiver in a power save mode which repeats a stop periodically, and a cycle of a stop are beforehand notified to said base transceiver station, To said power save mode from an active mode which maintains said receiver during communication with activation status. Or in performing a change to said active mode from said power save mode conversely, it notifies a mode change to said base transceiver station, When transmitting a packet to other addressing to a radio terminal and the address radio terminal concerned is in said power save mode, Let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-11 transmitting the packet concerned by said relay transfer method irrespective of whether the address radio terminal concerned is registered into said transfer-direct table.
[0061]According to this invention, though it obtained with the address radio terminals concerned and registered with a transfer-direct table while the address radio terminal was operating by a

power save mode, a relay transfer method is applied. Therefore, according to this invention, the situation where packet transfer by a transfer-direct method goes wrong by carrying out at an address radio terminal which is operating by a power save mode in addition to an effect of the invention concerning above-mentioned claims 1-12 can be avoided, and an effect that improvement in a throughput can be aimed at is acquired.

[0062]a time of said radio terminal transmitting a packet to other radio terminals, as for an invention concerning claim 13 -- being concerned -- others, in attesting between radio terminals and not succeeding in attestation, being concerned -- others -- irrespective of [whether a radio terminal is registered into said transfer-direct table] -- said relay transfer method -- being concerned -- others -- let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-12 performing packet transfer to a radio terminal.

[0063]If a packet is transmitted by a transfer-direct method when an address radio terminal refuses attestation, a problem of being discarded by the address radio terminal side is solved, a high throughput is obtained by this and packet transfer can be performed by the shortest possible packet transfer time.

[0064]Let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-13 when an invention concerning claim 14 transmits [said radio terminal] a packet by broadcasting, wherein it transmits the packet concerned by said relay transfer method.

[0065]According to this invention, when transmitting a broadcasting packet, a relay transfer method is applied, and when transmitting a unicast packet, a method concerning claims 1-13 will be followed. Therefore, according to this invention, it adds to an effect of the invention concerning above-mentioned claims 1-13, When transfer direct is performed, relay transfer can perform packet transfer also to a radio terminal which cannot receive a broadcasting packet, and an effect that reliability can be improved is acquired in packet transfer.

[0066]An invention concerning claim 15 detects whether said radio terminal is located in within the circle [of a service area of said base transceiver station], or it is located outside the circle, When located in the outside of the circle of a service area of said base transceiver station, let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-14 transmitting a packet by said transfer-direct method.

[0067]When a radio terminal is located in the outside of the circle of a service area of a base transceiver station according to this invention, Since a packet is transmitted by a transfer-direct method irrespective of whether an address radio terminal is registered into a transfer-direct table, useless packet transfer by a relay transfer method can be prevented, and an effect that improvement in a throughput and shortening of packet transfer time can be aimed at is acquired.

[0068]An invention concerning claim 16 makes a radio packet transfer method of a statement a gist at any 1 claim of claims 1-15, wherein said radio terminal erases registration of all the radio terminals in said transfer-direct table with a change of a base transceiver station which is an in-zone state place.

[0069]In a case where a transmitting agency radio terminal which is performing packet transfer by a transfer-direct method to a certain address radio terminal changes a base transceiver station in conventional technology, When the concerned transmitting former radio terminal changed and packet transfer was performed by a transfer-direct method to the same address radio terminal as a front, there was a problem that transmission may end in failure, but. According to this invention, after changing a base transceiver station, since a relay transfer method is applied, this problem is solvable first.

[0070]When an invention concerning claim 17 performs wireless packet communication with a

base transceiver station and two or more radio terminals and a radio terminal transmits a packet, When packet length of the packet concerned exceeds a fragmentation threshold set up beforehand, In a radio packet transfer method which divides the packet concerned and transmits so that packet length may become below in said fragmentation threshold, said radio terminal, When packet transfer by a relay transfer method that transmit a packet to said base transceiver station, and the base transceiver station concerned transmits the packet concerned to an address radio terminal is performed, Let a radio packet transfer method using a separate fragmentation threshold respectively by a case where packet transfer by a transfer-direct method which transmits the packet concerned to the address radio terminal concerned directly is performed be a gist.

[0071]According to this invention, since a fragmentation threshold which was suitable for each a case of a relay transfer method and in the case of a transfer-direct method can be used, improvement in a throughput can be aimed at.

[0072]When an invention concerning claim 18 performs wireless packet communication with a base transceiver station and two or more radio terminals and a radio terminal transmits a packet, When packet length of the packet concerned exceeds an RTS threshold set up beforehand, Give an identifier and said packet length of a local station to an RTS signal, transmit to an address radio terminal or said base transceiver station, and said address radio terminal or said base transceiver station, In permitting transmission of said packet by a transmitting agency radio terminal of said RTS signal, A radio terminal which gave and transmitted to a CTS signal respectively by having made into a permission address and a reservation period an identifier and packet length which were given to the RTS signal concerned, and transmitted an RTS signal, Said packet is transmitted when a CTS signal which includes an address of a local station as a permission address is received, In a radio packet transfer method which shelves transmission of an RTS signal and a packet until a period equivalent to a reservation period given to the CTS signal concerned expires, when a CTS signal which does not include an address of a local station as a permission address is received, When packet transfer by a relay transfer method that said radio terminal transmits a packet to said base transceiver station, and the base transceiver station concerned transmits the packet concerned to an address radio terminal is performed, Let a radio packet transfer method using a separate RTS threshold respectively by a case where packet transfer by a transfer-direct method which transmits the packet concerned to the address radio terminal concerned directly is performed be a gist.

[0073]According to this invention, since an RTS threshold which was suitable for each a case of a relay transfer method and in the case of a transfer-direct method can be used, improvement in a throughput can be aimed at.

[0074]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to drawings.

[0075]A. Example drawing 1 of composition of the network with which each embodiment of this invention is applied shows the example of composition of the network with which each embodiment of this invention is applied. In this network, each base transceiver stations 10 and 10 and -- accommodate two or more radio terminals. The base transceiver station 10 and the wired terminal 20 are connected by Ethernet 30. Communication with a host (graphic display abbreviation) is performed via one of base transceiver stations with the radio terminals 1, 2, 3, and 4 and --. The base transceiver stations 10 and 10 and -- memorize respectively the MAC Address of the radio terminal which a local station accommodates to the accommodation

terminal table 11.
[0076]B. A 1st embodiment book embodiment is an embodiment of a radio packet transfer system which enforces the radio packet transfer method concerning claim 1, The judgment about the above "registration condition" is performed according to the invention concerning claim 2, and the judgment about the above "registration cancellation conditions" is performed according to the invention concerning claim 5.
[0077]Drawing 2 shows the format of the radio packet delivered and received in this embodiment between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station, drawing 2 (a) shows the format of a data packet, and drawing 2 (b) shows the format of the ACK signal (reply signal). The data packet is constituted by a header, data, and frame-check-sequence FCS as shown in drawing 2 (a).
[0078]And the header includes destination address DA, transmission source address SA, a packet kind (a packet kind is "0000" in the case of a data packet), and transmission classification.
[0079]Here, destination address DA is a MAC Address of the radio terminal of an address, or a wired terminal. Transmission source address SA is a MAC Address of the radio terminal of a transmitting agency, or a wired terminal. Transmission classification is information which specifies the transfer method of the packet concerned, It is referred to as "00" when the packet concerned is what is transmitted from a radio terminal that the transfer-direct method should be enforced, It is referred to as "01" at a being [it / what is transmitted from a radio terminal that the relay transfer method should be enforced] case, and it is referred to as "10" when transmitted from a base transceiver station that the relay transfer method should be enforced.
[0080]The ACK signal is constituted by destination address DA, a packet kind (a packet kind is "0001" in the case of an ACK signal), and frame-check-sequence FCS as shown in drawing 2 (b).
[0081]Drawing 3 is a flow chart which shows the example of the receiving operation of the data packet of the radio terminal in this embodiment. In this embodiment, each radio terminal has memorized the transfer-direct table illustrated to drawing 4. Let the MAC Address of the radio terminal judged as the ability of this transfer-direct table to perform packet transfer by the transfer-direct method from the radio terminal concerned be a component. In the receiving operation of the radio terminal in this embodiment, registration of the MAC Address of a radio terminal to this transfer-direct table is performed. In this example of operation, the judgment about the "registration condition" of whether to register a radio terminal to a transfer-direct table has adopted the method set to m1=1 in the invention concerning claim 2. Of course, changing the flow of drawing 3 so that m's1 can be carried out in such a mode well also as two or more is being able to accomplish easily if it is a person skilled in the art. Hereafter, the details are explained with reference to the flow shown in drawing 3.
[0082]A radio terminal's reception of a data packet will judge first whether frame-check-sequence FCS is normal (Step S101). When this decision result is "NO", reception is ended after discarding the packet concerned (Step S110), and in being "YES", it progresses to Step S102.
[0083]Next, if it progresses to Step S102, it judges whether the transmission classification of the data packet which received is "10", when transmission classification is "10", it progresses to Step S106, and in not being "10", it will progress to Step S103.
[0084]Next, if it progresses to Step S103, it judges whether the receiving level of the data packet concerned is more than threshold L1, and when this decision result is "NO", it will progress to Step S106, and, in "YES", will progress at Step S104.
[0085]Next, if it progresses to Step S104, it judges whether the transmission source address of

the data packet concerned is registered into the transfer-direct table, and when this decision result is "YES", it will progress to Step S106, and, in "NO", will progress to Step S105. Next, if it progresses to Step S105, the transmission source address of the data packet concerned will be registered into a transfer-direct table. And it progresses to Step S106.
[0086]Thus, when reception of a data packet is performed. the transmission classification being "00" or "01" (namely, -- the data packet concerned is transmitted by the transfer-direct method or the relay transfer method from other radio terminals), and, And when the receiving level is more than threshold L1, the address of the radio terminal which is the transmitting origin of the data packet concerned is registered into a transfer-direct table. In this case, registration is performed regardless of whether it addresses to a radio terminal besides whether the data packet concerned is a thing addressed to a local station etc.
[0087]Next, if it progresses to Step S106, it will be judged whether the destination address of the data packet concerned is in agreement with the address of a local station. When this decision result is "NO", reception is ended after discarding the packet concerned (Step S110), and in being "YES", it progresses to Step S107.
[0088]Next, if it progresses to Step S107, it will be judged whether the transmission classification of the data packet concerned is "01." When this decision result is "YES", reception is ended after discarding the packet concerned (Step S110). The packet concerned is because it is a normal receiving gestalt which it should be transmitted to a local station by the relay transfer method, and is received via a base transceiver station, although it addressed to the local station and was transmitted to it from other radio terminals.
[0089]on the other hand, when the decision result of Step S107 is "YES", When transfer direct of the data packet concerned is carried out to a local station from other radio terminals (transmission classification "00"), or when relay transfer of the data packet concerned is carried out to a local station via a base transceiver station from other radio terminals (transmission classification "10"), it progresses to Step S108.
[0090]Next, an ACK signal will be transmitted if it progresses to Step S108. When the data packet which received is transmitted from other radio terminals by the transfer-direct method here (transmission classification "00"), When an ACK signal is transmitted to addressing to a radio terminal which is the transmitting origin of the data packet concerned and the data packet concerned is transmitted from a base transceiver station by the relay transfer method (transmission classification "10"), an ACK signal is transmitted to a base transceiver station.
[0091]Next, if it progresses to Step S109, the data packet which received will be passed to the upper layer and reception will be ended.
[0092]In the receiving operation concerning this embodiment described above, it becomes possible to choose relay transfer to the radio terminal which does not fulfill transfer direct and quality to the radio terminal which fulfills the quality at the time of transfer direct by making the threshold L1 into the receiving level with which it is satisfied of necessary quality.
[0093]Next, with reference to the flow chart shown in drawing 5, the send action of the data packet of the radio terminal in this embodiment is explained. Although this send action includes the processing which erases registration of the radio terminal in a direct communication table, the judgment method which starts claim 5 as the judgment method about the "registration cancellation conditions" whether to erase registration of a certain radio terminal is used for it.
[0094]First, in a radio terminal, if the Request to Send of a data packet arises, a built-in retry counter will be set as "1" (Step S201). Next, it is judged whether the destination address of the data packet concerned is registered into the transfer-direct table (Step S202). When this decision

result is "YES", it progresses to Step S203, and in "NO", it progresses to Step S210.
[0095]Next, if it progresses to Step S203 from Step S202, the transfer-direct method will be chosen. Next, it progresses to Step S204, the transmission classification "00" corresponding to the transfer-direct method is set as a data packet, and the data packet concerned is transmitted.
[0096]Next, it progresses to Step S205 and it is judged whether the ACK signal from the radio terminal of an address was received. When this decision result is "YES", with an address radio terminal, the data packet which transmitted considers that it was received normally, and ends a send action.
[0097]On the other hand, when the decision result of Step S205 is "NO", it progresses to Step S206, and it is judged whether the value of a retry counter is smaller than the predetermined threshold m2. And when this decision result is "YES", only "1" makes the value of a retry counter increase (Step S207), only the standby time determined at random stands by (Step S208), and a data packet is transmitted again (Step S204). Hereafter, similarly, an ACK signal is not received from a destination terminal, and when the value of a retry counter is less than [m2], Step S207, S208, and Step S204 are repeated.
[0098]And without receiving an ACK signal, when the value of a retry counter reaches the threshold m2, it progresses to Step S209 from Step S206. If it progresses to this step S209, the destination address of the data packet which is a transmission object will be deleted from a transfer-direct table. It is because it is considered to be difficult to the radio terminal of such a destination address to carry out packet transfer by the transfer-direct method. After processing of this step S209 is completed, it progresses to Step S210. As already explained, also when the destination address of the data packet concerned besides at the time of passing through processing of the above-mentioned step S209 is not registered into a transfer-direct table, it will progress to Step S210.
[0099]Next, if it progresses to Step S210, the relay transfer method will be chosen. Next, it progresses to Step S211, the transmission classification "01" corresponding to the relay transfer method is set as a data packet, and the data packet concerned is transmitted.
[0100]Next, it progresses to Step S212 and it is judged whether the ACK signal from the base transceiver station of an address was received. When this decision result is "YES", it considers that the data packet which transmitted was received normally, and a send action is ended.
[0101]On the other hand, when the decision result of Step S212 is "NO", it progresses to Step S213, and it is judged whether the value of a retry counter is smaller than the predetermined maximum retry count N (however, it is N>m2.). And when this decision result is "YES", only "1" makes the value of a retry counter increase (Step S214), only the standby time determined at random stands by (Step S215), and a data packet is transmitted again (Step S211). Similarly an ACK signal is not hereafter received from the base transceiver station which is an address, and when the value of a retry counter is less than N, Step S214, S215, and Step S211 are repeated.
[0102]And when the value of a retry counter becomes the maximum retry count N, without receiving an ACK signal, it progresses to Step S216 from Step S213, a transmission data packet is discarded, and transmitting processing is ended.
[0103]According to the send action of the data packet in the radio terminal explained above. Even when an address radio terminal foresees during communication of a transmitting agency radio terminal and it moves to the position in which outer transfer direct is impossible, the method of the packet transfer applied to the address radio terminal concerned can be changed into the relay transfer method from the transfer-direct method.
[0104]With reference to the flow chart shown in following drawing 6, the packet relay operation

of the base transceiver station in this embodiment is explained. First, if it is the data packet transmitted from the radio terminal and transmission classification receives what is "01" (namely, data packet transmitted from the radio terminal that the relay transfer method should be enforced), a base transceiver station, An ACK signal is transmitted to the radio terminal which is a transmitting agency (Step S301), and the address of the data packet which received judges whether it is a radio terminal accommodated in the base transceiver station concerned (Step S302). A base transceiver station judges whether the address of the data packet concerned is a radio terminal accommodated in the base transceiver station concerned, also when the data packet transmitted from the wired terminal is received (Step S302).

[0105]Processing is ended without performing packet relay operation, when the decision result of this step S302 is "NO."

[0106]On the other hand, when the decision result of Step S302 is "YES", That is, when the address of the data packet which received from the above-mentioned radio terminal or the wired terminal is the radio terminal accommodated in the base transceiver station concerned, relay operation which transmits the data packet concerned to the address radio terminal concerned is performed by the following procedures.

[0107]First, it progresses to Step S303 and the value of a retry counter is set to "1." Next, it progresses to Step S304, the transmission classification "10" which indicates that it is the data packet transmitted from the base transceiver station that the relay transfer method should be enforced is set as the data packet concerned, and it transmits to the addressing to an address radio terminal concerned.

[0108]Next, it progresses to Step S305 and it is judged whether the ACK signal from an address radio terminal was received. When this decision result is "YES", it considers that the data packet which transmitted was received normally, and relay operation is ended.

[0109]On the other hand, when the decision result of Step S305 is "NO", it progresses to Step S306, and it is judged whether the value of a retry counter is smaller than the predetermined maximum retry count N. And when this decision result is "YES", only "1" makes the value of a retry counter increase (Step S307), only the standby time determined at random stands by (Step S308), and a data packet is transmitted again (Step S304). Hereafter, similarly, an ACK signal is not received from an address radio terminal, and when the value of a retry counter is less than N, Step S307, S308, and Step S304 are repeated.

[0110]And when the value of a retry counter becomes the maximum retry count N, without receiving an ACK signal, it progresses to Step S309 from Step S306, the data packet concerned is discarded, and relay processing is ended.

[0111]By operation of the base transceiver station explained above, the packet relay from the relay transfer and the wired terminal of a data packet to other radio terminals [radio terminal] to a radio terminal is attained.

[0112]Next, drawing 7 - drawing 12 show various kinds of examples of operation in this embodiment. Hereafter, with reference to these figures, the example of concrete operation of this embodiment is explained.

[0113]First, the operating-sequence figure of drawing 7 shows the example of operation in case a certain radio terminal B transmits a data packet to addressing to radio terminal A registered into the transfer-direct table. The radio terminal A is registered into the transfer-direct table of the radio terminal B in this example of operation. For this reason, when the data packet which should be transmitted to radio terminal A occurs, the radio terminal B sets transmission classification of the data packet concerned to "00", and makes a destination address the MAC Address of the

radio terminal A, and transmits by the transfer-direct method.
[0114]If this data packet is received, the radio terminal A judges whether that receiving level is more than threshold L1, and when it is less than [threshold L1], it will not perform registration to a transfer-direct table. On the other hand, when a receiving level is more than threshold L1, the MAC Address of the radio terminal B which is a transmitting agency is registered into a transfer-direct table. It transmits an ACK signal to addressing to radio terminal B which is the transmitting origin of the data packet concerned while it hands over the data packet concerned to the upper layer, since the data packet which received makes the MAC Address of the radio terminal A a destination address.
[0115]In the radio terminal B side, by reception of this ACK signal, it recognizes that transmission of the above-mentioned data packet was successful, and transmitting processing is ended.
[0116]As explained above, according to this embodiment, about the radio terminal registered into the transfer-direct table. Since a data packet is transmitted to an address radio terminal by the transfer-direct method which does not go via a base transceiver station, while reducing the overheads of relay, the time required of transmission can be shortened.
[0117]Next, in the case where the operating-sequence figure of drawing 8 transmits a data packet to addressing to radio terminal C by which the radio terminal A was registered into the transfer-direct table, The third party slack radio terminal B receives the data packet of this addressing to radio terminal C, and the example of operation in the case of registering the radio terminal A into a transfer-direct table is shown.
[0118]The radio terminal C is registered into the transfer-direct table of the radio terminal A in this example of operation. For this reason, when the data packet which should be transmitted to radio terminal C occurs, the radio terminal A sets transmission classification of the data packet concerned to "00", and makes a destination address the MAC Address of the radio terminal C, and transmits by the transfer-direct method.
[0119]The radio terminal C will transmit an ACK signal to radio terminal A, if this data packet is received. By receiving this ACK signal, the radio terminal A recognizes that transmission of packet data was successful, and ends transmitting processing.
[0120]On the other hand, when the radio terminal B is located in the good place of a prospect for the radio terminal A, the data packet of addressing to radio terminal C transmitted from the radio terminal A may be received by the third party slack radio terminal B. In this case, the radio terminal B judges whether the receiving level of a data packet is more than threshold L1, and when it is more than threshold L1, it registers the MAC Address of the radio terminal A which is the transmitting origin of the data packet which received into a transfer-direct table. Since the data packet which received is a thing addressed to radio terminal C, it is discarded. On the other hand, when a receiving level is less than [threshold L1], registration to a transfer-direct table is not performed.
[0121]As explained above, when a radio terminal receives the data packet of addressing to a radio terminal of others, and the receiving level is beyond a predetermined threshold, the radio terminal which is a transmitting agency is registered into a transfer-direct table by this embodiment. Therefore, when it is considered as the address of transfer direct, only the high radio terminal of ****** which can perform transfer direct by predetermined communication quality will be registered into a transfer-direct table, and the frequency of failure at the time of performing the transfer-direct method can be lessened.
[0122]Next, the operating-sequence figure of drawing 9 shows the example of operation in case

relay transfer is performed from the radio terminal A to the radio terminal B by going via a base transceiver station. The MAC Address of the radio terminal B is not registered into the transfer-direct table of the radio terminal A in this example of operation. For this reason, the radio terminal A chooses the relay transfer method, when the data packet which should transmit to radio terminal B occurs, it makes a destination address the MAC Address of the radio terminal B, sets transmission classification to "01", and transmits the data packet concerned.
[0123]Since the transmission classification is "01" when the above-mentioned data packet is received, a base transceiver station transmits an ACK signal to the radio terminal A.
[0124]By receiving this ACK signal, the radio terminal A recognizes a transmitting success and ends transmitting processing.
[0125]On the other hand, since the address of the above-mentioned data packet is the radio terminal B accommodated in the base transceiver station concerned, a base transceiver station sets transmission classification of the data packet concerned to "10", and transmits the data packet concerned.
[0126]If this data packet is received, that transmission classification is "10", and since that destination address of the radio terminal B corresponds with the address of a local station, it will hand over the data packet concerned to the upper layer, and will transmit an ACK signal to a base transceiver station. By receiving this ACK signal, a base transceiver station recognizes a transmitting success of a data packet, and ends transmitting processing.
[0127]Next, although the radio terminal A transmits a data packet to the radio terminal B registered into the transfer-direct table by the transfer-direct method, the operating-sequence figure of drawing 10 fails in this transmission, and shows the example of operation in the case of changing to the relay transfer method. It is being referred to as m2=1 in this example of operation.
[0128]The MAC Address of the radio terminal B is registered into the transfer-direct table of the radio terminal A in this example of operation. For this reason, the radio terminal A chooses the transfer-direct method, when the data packet which should transmit to radio terminal B occurs, it makes a destination address the MAC Address of the radio terminal B, sets transmission classification to "00", and transmits the data packet concerned.
[0129]However, when the radio terminal B is moving out of this time, for example, the prospect of the radio terminal A, transmission of the above-mentioned data packet will be finished with failure. In this case, although resending of a data packet is performed for the value of a retry counter during the period below threshold m2, if the value of a retry counter reaches the threshold m2, the radio terminal A will erase registration of the radio terminal B in a transfer-direct table.
[0130]Then, the radio terminal A transmits the transmission classification of the data packet addressed to radio terminal B as "01."
[0131]Since the transmission classification is "01" when the above-mentioned data packet is received, a base transceiver station transmits an ACK signal to the radio terminal A.
[0132]By receiving this ACK signal, the radio terminal A recognizes a transmitting success and ends transmitting processing.
[0133]On the other hand, since the address of the above-mentioned data packet is the radio terminal B accommodated in the base transceiver station concerned, a base transceiver station sets transmission classification of the data packet concerned to "10", and transmits the data packet concerned.
[0134]If this data packet is received, that transmission classification is "10", and since that

destination address of the radio terminal B corresponds with the address of a local station, it will hand over the data packet concerned to the upper layer, and will transmit an ACK signal to a base transceiver station. By receiving this ACK signal, a base transceiver station recognizes a transmitting success of a data packet, and ends transmitting processing.
[0135]Although each example of operation explained above is a thing in case the address radio terminal and the transmitting agency radio terminal are accommodated in the same base transceiver station, Also in the case where it is respectively accommodated in two base transceiver stations where the radio terminal A which delivers and receives a data packet, and the radio terminal B adjoin so that it may illustrate to drawing 11, Registration of the same transfer-direct table as the above and registration cancellation can be performed, and packet transfer by the transfer-direct method or the relay transfer method can be performed.
[0136]Next, the operating-sequence figure of drawing 12 shows the example of operation in the case of performing packet transfer from the radio terminal A in drawing 11 to the wired terminal Z. First, suppose that the data packet which should transmit to wired terminal Z occurred in the radio terminal A. In this case, since the wired terminal Z is not registered into the transfer-direct table of the radio terminal A, the radio terminal A chooses the relay transfer method, makes a destination address the MAC Address of the wired terminal Z, and transmits transmission classification as "01."
[0137]If this data packet is received, since that transmission classification is "01", a base transceiver station will transmit an ACK signal to the transmitting agency radio terminal A. The radio terminal A recognizes a transmitting success by reception of this ACK signal, and ends transmitting processing.
[0138]On the other hand, since the destination address of the above-mentioned data packet is not a thing of the radio terminal accommodated in the base transceiver station concerned, a base transceiver station changes the data packet concerned into an Ethernet packet, and transmits to Ethernet.
[0139]If the above-mentioned Ethernet packet is received via Ethernet, since the destination address and address of a local station of the wired terminal Z correspond, it will hand over the Ethernet packet concerned to the upper layer.
[0140]As explained above, packet transfer of addressing to a wired terminal by the relay transfer method can be performed without according to this embodiment, producing the useless resending packet by transfer direct, even when an address is a wired terminal.
[0141]In the above, the case where performed a judgment concerning a "registration condition" in the embodiment of the invention concerning claim 1 by the judgment method concerning claim 2, and the judgment about "registration cancellation conditions" was performed by the judgment method concerning claim 5 was explained to the example. However, the judgment method about the "registration condition" and the "registration cancellation conditions" which were adopted in this embodiment is illustration to the last. In carrying out this invention, the judgment method which starts claim 6 or 7 instead of the judgment method which may adopt the judgment method which starts claim 3 or 4 instead of the judgment method concerning claim 2, and starts claim 5 may be adopted.
[0142]C. It is a radio packet transfer method concerning claim 1, and a 2nd embodiment book embodiment performs the judgment about a "registration condition" by the judgment method concerning claim 2, and it uses together the judgment method which starts the judgment method and claim 8 concerning claim 5 in the judgment about "registration cancellation conditions", and perform it.

[0143]In this embodiment, the format of the radio packet delivered and received between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station is as having been shown in above-shown drawing 2 like a 1st embodiment of the above. Like a 1st embodiment of the above, each radio terminal memorizes the transfer-direct table illustrated to above-shown drawing 4, and performs selection of the transfer-direct method or the relay transfer method according to the contents of registration of this transfer-direct table.
[0144]Drawing 13 is a flow chart which shows the receiving operation of the data packet of the radio terminal in this embodiment. In this receiving operation, the judgment about a "registration condition" is performed by the judgment method set to m1=1 in claim 2, and the judgment about "registration cancellation conditions" is performed by the judgment method set to m3=1 in claim 8. Of course, changing the flow of drawing 13 so that m1 or m3 can be carried out in such a mode well also as two or more is being able to accomplish easily if it is a person skilled in the art.
[0145]A radio terminal will judge first whether frame-check-sequence FCS of the data packet concerned is normal, if a data packet is received (Step S301). And when frame-check-sequence FCS is normal, it progresses to Step S402. When abnormalities are observed in frame-check-sequence FCS, the data packet which received is discarded (Step S413), and reception is ended.
[0146]Next, if it progresses to Step S402, it will be judged whether the transmission classification of the data packet which received is "10." When this decision result is "YES", it progresses to Step S409.
[0147]On the other hand, when the data packet which received is received from a radio terminal that the transfer-direct method should be enforced (transmission classification = "00"), or when the data packet concerned is received from a radio terminal that the relay transfer method should be enforced (transmission classification = "01"). The decision result of Step S402 serves as "NO", and will progress to Step S403.
[0148]Next, if it progresses to Step S403, it will be judged whether the receiving level at the time of reception of the data packet concerned is more than threshold L1. When this decision result is "YES", it progresses to Step S404, and it is judged whether the transmission source address of the data packet concerned is registered into the transfer-direct table of the radio terminal concerned. And when this decision result is "NO", he registers the transmission source address concerned into a transfer-direct table (Step S405), and follows it to Step S409. When the decision result of the above-mentioned step S404 is "YES", it progresses to Step S409, without performing registration (Step S405) to a transfer-direct table.
[0149]On the other hand, when the receiving level of a data packet is less than [threshold L1], it progresses to Step S406 from Step S403, and it is judged whether the receiving level of a data packet is more than threshold L2. Here, when a receiving level is more than threshold L2, it progresses to Step S409. On the other hand, when a receiving level is less than [threshold L2], it is judged whether the transmission source address of the data packet concerned is registered into the transfer-direct table of the radio terminal concerned (Step S407). And when this decision result is "YES", registration of the transmission source address concerned in a transfer-direct table is erased (Step S408), and it progresses to Step S409. When the decision result of the above-mentioned step S407 is "NO", it progresses to Step S409, without performing registration cancellation (Step S408) in a transfer-direct table.
[0150]Thus, when reception of a data packet is performed in this embodiment. the transmission classification being "00" or "01" (namely, -- the data packet concerned is transmitted by the transfer-direct method or the relay transfer method from other radio terminals), and, And when

the receiving level is more than threshold L1, the transmitting agency radio terminal of the data packet concerned is registered into a transfer-direct table. Reception of the data packet whose transmission classification is "00" or "01" is performed, and when the receiving level at that time is less than [threshold L2], registration of the transmitting agency radio terminal of the data packet concerned in a transfer-direct table is canceled. In this case, registration and registration cancellation are performed regardless of whether it addresses to a radio terminal besides whether the data packet concerned is a thing addressed to a local station etc.

[0151]Next, if it progresses to Step S409, it will be judged whether the destination address of the data packet concerned is in agreement with the address of a local station. When this decision result is "NO", reception is ended after discarding the packet concerned (Step S413), and in being "YES", it progresses to Step S410.

[0152]Next, if it progresses to Step S410, it will be judged whether the transmission classification of the data packet concerned is "01." When this decision result is "YES", reception is ended after discarding the packet concerned (Step S413). The packet concerned is because it is a normal receiving gestalt which it should be transmitted to a local station by the relay transfer method, and is received via a base transceiver station, although it addressed to the local station and was transmitted to it from other radio terminals.

[0153]on the other hand, when the decision result of Step S410 is "NO", When transfer direct of the data packet concerned is carried out to a local station from other radio terminals (transmission classification "00"), or when relay transfer of the data packet concerned is carried out to a local station via a base transceiver station from other radio terminals (transmission classification "10"), it progresses to Step S411.

[0154]Next, an ACK signal will be transmitted if it progresses to Step S411. When the data packet which received is transmitted from other radio terminals by the transfer-direct method here (transmission classification "00"), When an ACK signal is transmitted to addressing to a radio terminal which is the transmitting origin of the data packet concerned and the data packet concerned is transmitted from a base transceiver station by the relay transfer method (transmission classification "10"), an ACK signal is transmitted to a base transceiver station.

[0155]Next, if it progresses to Step S412, the data packet which received will be passed to the upper layer and reception will be ended.

[0156]In the receiving operation concerning this embodiment described above, it becomes possible to choose relay transfer to the radio terminal which does not fulfill transfer direct and quality to the radio terminal which fulfills the quality at the time of transfer direct by making the thresholds L1 and L2 into the receiving level with which it is satisfied of necessary quality. The change frequency of transfer direct and relay transfer can be controlled by being referred to as L1>L2. Therefore, when the control load accompanying the change of transfer direct and relay transfer is large, the influence which it has on a radio terminal can be inhibited.

[0157]In the state where the radio terminal A is registered into the transfer-direct table of the radio terminal B, and the radio terminal B is registered into the transfer-direct table of the radio terminal A, drawing 14 shows the example of an operating sequence when packet transfer by the transfer-direct method is performed from the radio terminal A to the radio terminal B.

[0158]As shown in this drawing 14, the radio terminal B will judge whether that receiving level is more than threshold L2, if the packet from the radio terminal A is received. Although the radio terminal A and the radio terminal B were performing communication by the transfer-direct method till then here, when it moves to the place which the radio terminal B left distantly [radio terminal / A], the above-mentioned receiving level in the radio terminal B may be less than [

threshold L2]. In such a case, in the radio terminal B, the registration in the transfer-direct table of the radio terminal A which is the transmitting origin of the packet concerned is erased. About the packet which received, it hands over to the upper layer, and an ACK signal is transmitted to radio terminal A.

[0159]By thus, the cause of relative physical relationship with the radio terminal registered into the transfer-direct table getting worse according to this embodiment. When deterioration of the communication quality at the time of performing transfer direct to the addressing to a radio terminal concerned is expected, registration of the radio terminal concerned in a transfer-direct table will be erased, and packet transfer of the addressing to a radio terminal concerned will be performed by the relay transfer method that necessary quality can be maintained.

[0160]As mentioned above, although the characteristic example of this embodiment of operation was explained, about other operations, it is the same as that of operation of a 1st embodiment of the above that already explained. That is, the flow of the send action of the packet of the radio terminal in this embodiment is the same as what was already explained with reference to drawing 5. In operation of the packet transmission shown to drawing 5 that it already explained, the judgment about "registration cancellation conditions" is performed by the judgment method concerning claim 5. Therefore, at this embodiment, the judgment about "registration cancellation conditions" will be performed in accordance with the judgment method which starts claim 8 in the receiving operation (drawing 13) of a radio terminal, and the judgment about "registration cancellation conditions" will be performed in accordance with the judgment method concerning claim 5 by the send action of a radio terminal. The judgment method which starts claim 8 in this way, and the judgment method concerning claim 5 may not be used together, but only the judgment method concerning claim 8 may be used, and the judgment by the judgment method concerning claim 5 may be omitted.

[0161]The operation flow of the packet relay of the base transceiver station in this embodiment is the same as what was already explained with reference to drawing 6. The example of an operating sequence in case a radio terminal transmits a packet to addressing to a radio terminal registered into the transfer-direct table is the same as what was shown in above-shown drawing 7, and the example of an operating sequence in case a radio terminal registers other radio terminals into a transfer-direct table is the same as what was shown in above-shown drawing 8. The example of an operating sequence in case a radio terminal furthermore transmits a packet to addressing to a radio terminal which is not registered into a transfer-direct table is the same as what was shown in above-shown drawing 9. The operating sequence when the packet to which the radio terminal B is registered into the transfer-direct table of the radio terminal A, for example, and the radio terminal B was transmitted from the radio terminal A is unreceivable is the same as what was shown in above-shown drawing 10. Also in the case where it is respectively accommodated in two base transceiver stations where the radio terminal A which delivers and receives a data packet, and the radio terminal B adjoin so that it may illustrate to above-shown drawing 11, Registration of the same transfer-direct table as the above and registration cancellation can be performed, and packet transfer by the transfer-direct method or the relay transfer method can be performed. The operating sequence in case a radio terminal and a wired terminal perform packet transfer is the same as that of what was shown in above-shown drawing 12.

[0162]As mentioned above, although this embodiment was described to the example, the case where perform the judgment about a "registration condition" by the judgment method concerning claim 2, and it carries out by using together the judgment method which starts the judgment

method and claim 8 concerning claim 5 in the judgment about "registration cancellation conditions", The judgment method which starts claim 9 or 10 instead of the judgment method which uses the judgment method which starts claim 6 or 7 instead of the judgment method which uses the judgment method which starts claim 3 or 4 instead of the judgment method concerning claim 2, or starts claim 5, or starts claim 8 may be used. As mentioned above, the judgment by the judgment method concerning claim 5 may be omitted.

[0163]D. In a 3rd embodiment book embodiment, the format of the radio packet delivered and received between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station is as having been shown in above-shown drawing 2 like each above-mentioned embodiment. Like each above-mentioned embodiment, each radio terminal memorizes the transfer-direct table illustrated to above-shown drawing 4, and performs selection of the transfer-direct method or the relay transfer method according to the contents of registration of this transfer-direct table. In this embodiment, a watchdog timer is prepared for each [register with a transfer-direct table] radio terminal of every. About the directions for these watchdog timers, it clarifies in explanation of this embodiment of operation.

[0164]In this embodiment, the radio terminal of the registration condition for registering the MAC Address of arbitrary radio terminals into a transfer-direct table is the same as that of what was already explained in each above-mentioned embodiment.

[0165]He is trying to, require that following either should be filled with this embodiment on the other hand about the registration cancellation conditions for deleting the MAC Address of a radio terminal from a transfer-direct table.

[0166]Registration cancellation condition **: The situation of having transmitted a packet from a local station by the transfer-direct method to the radio terminal concerned, and becoming packet transmission non completion occurred by the frequency beyond a predetermined limit (equivalent to claims 5-7).

[0167]Registration cancellation condition **: The situation where a local station received the packet transmitted with the radio terminal concerned with the receiving level of less than a predetermined threshold occurred by the frequency beyond a predetermined limit (equivalent to claims 8-10).

[0168]Registration cancellation condition ** : The situation where a local station receives the packet which fixed time and the radio terminal concerned transmitted with the receiving level beyond a predetermined threshold does not arise once, And the thing which the situation of transmitting a packet from a local station to the radio terminal concerned, and becoming packet transmission completion does not produce once (equivalent to claim 11).

[0169]A 2nd embodiment of the above is also used for registration cancellation condition ** and ** among the above. In addition to these, the above-mentioned registration cancellation condition ** is used for this embodiment.

[0170]Drawing 15 and drawing 16 are flow charts which show the receiving operation of the data packet of the radio terminal in this embodiment. In most [of receiving operation] most [flows (above-shown drawing 13) and] of a radio terminal in a 2nd embodiment of the above, the flow of this receiving operation is the same. However, Steps S405 and S408 in above-shown drawing 13 are transposed to Step S405A and S408A by this embodiment on the relation which newly added the above-mentioned registration cancellation condition **, and still newer step S421 A-S 423A in this embodiment is added. About other steps, there are not a thing of above-shown drawing 13 and a change. About these, what was used in above-shown drawing 13, and a common thing are used as a number of a step.

[0171]It is as follows when the main point of the receiving operation of the data packet of a radio terminal is explained according to the flow of drawing 15 and drawing 16.
[0172]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet beyond threshold L1, The address of the transmitting agency radio terminal of the data packet concerned is registered into a transfer-direct table, and the watchdog timer corresponding to the concerned transmitting former radio terminal is started (Step S401, S402, S403, S404, S405A). However, when the address of the transmitting agency radio terminal of the data packet concerned is already registered into the transfer-direct table, only processing which restarts a watchdog timer is performed (Step S401, S402, S403, S404, S421A).
[0173]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet below threshold L2, Registration of the address of the transmitting agency radio terminal of the data packet concerned in a transfer-direct table is erased, and the watchdog timer corresponding to the concerned transmitting former radio terminal is stopped (Step S401, S402, S403, S406, S407, S408A).
[0174]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet beyond threshold L2, A watchdog timer is restarted when the address of the transmitting agency radio terminal of the data packet concerned is already registered into the transfer-direct table (Step S401, S402, S403, S406, S422A, S423A).
[0175]The above is the contents of processing of the transfer-direct table relation performed with reception of the data packet by a radio terminal, and watchdog timer-related processing. It is judged whether after finishing these processings, a radio terminal is the transmission classification "00" or the data packet of "10" which the data packet addressed to the local station (Step S409, S410), When this decision result is affirmative, transmission of an ACK signal and delivery to the upper layer of a data packet are performed (Step S412). About the processing after this step S409, there are not a 2nd embodiment of the above and a place which changes in any way.
[0176]Next, drawing 17 is a flow chart which shows the send action of the data packet of the radio terminal in this embodiment. In most [of a send action] most [flows (above-shown drawing 5) and] of a radio terminal in a 1st embodiment of the above, the flow of this send action is the same. However, Step S209 in above-shown drawing 5 is transposed to Step S209A by this embodiment on the relation which newly added the above-mentioned registration cancellation condition **, and the still newer step S221A in this embodiment is added. About other steps, there are not a thing of above-shown drawing 5 and a change. About these, what was used in above-shown drawing 5, and a common thing are used as a number of a step.
[0177]It is as follows when the main point of the send action of the data packet of a radio terminal is explained according to the flow of drawing 17.
[0178]A radio terminal restarts the watchdog timer corresponding to an address radio terminal, when transmission classification receives an ACK signal after transmission of the data packet which is "00" (transfer direct) (Step S201, S202, S203, S204, S205, S221A).
[0179]After a radio terminal transmits the data packet whose transmission classification is "00" (transfer direct), at however, the time of ** in which a radio terminal does not receive an ACK signal continuously twice [m]. While erasing registration of the address of the address radio terminal concerned in a transfer-direct table, the watchdog timer corresponding to the address radio terminal concerned is stopped (Step S205, S206, S209A).
[0180]In this case, resending of the data packet concerned is performed by the relay transfer method (Steps S210-S216). Since it is the same as what was already explained in a 1st

embodiment about this relay transfer method, explanation is omitted here.
[0181]Now, as already explained, the radio terminal in this embodiment performs the time check by a watchdog timer about each radio terminal which registered the address into the transfer-direct table (Step S405A of drawing 15). And if one of watchdog timers becomes time over, the watchdog timer exaggerated routine shown in drawing 18 will perform the radio terminal concerning this embodiment, and the address of the radio terminal corresponding to the watchdog timer used as time over will be deleted from a transfer-direct table.
[0182]When the watchdog timer which started the time check receives a data packet with the receiving level beyond threshold L1 from the radio terminal corresponding to the watchdog timer concerned here (Step S421A of drawing 15), A data packet is received with the receiving level beyond threshold L2 from the radio terminal corresponding to the watchdog timer concerned, And when the radio terminal concerned is registered into the transfer-direct table (Step S423A of drawing 15), or when a data packet is transmitted to the radio terminal corresponding to the watchdog timer concerned by the transfer-direct method and an ACK signal is received (Step S221A of drawing 17), it restarts.
[0183]Therefore, cover fixed time (timer set time of a watchdog timer), and a data packet is not received once with the threshold L1 or the receiving level beyond L2 from the radio terminal corresponding to the watchdog timer concerned, And a data packet is transmitted by the transfer-direct method to the radio terminal corresponding to the watchdog timer concerned, When the situation where it ends with a success does not arise once, (registration cancellation condition ** mentioned above) and the watchdog timer concerned serve as time over, and the registration to the transfer-direct table of the radio terminal corresponding to the watchdog timer concerned is canceled.
[0184]Next, with reference to drawing 19 - each operating-sequence figure of drawing 22, various kinds of examples of this embodiment of operation are explained still more concretely.
[0185]First, drawing 19 shows the operating sequence in case a radio terminal transmits a data packet to addressing to a radio terminal registered into the transfer-direct table by the transfer-direct method.
[0186]The radio terminal A is registered into the transfer-direct table of the radio terminal B in drawing 19. For this reason, in the radio terminal B, if the data packet which should be transmitted to radio terminal A arises, the radio terminal B will choose the transfer-direct method, will make a destination address the MAC Address of the radio terminal A, will set transmission classification to "00", and will transmit the data packet concerned.
[0187]If this data packet is received, it judges a receiving level, and the radio terminal A will register the MAC Address of the transmitting agency radio terminal B into a transfer-direct table, when a receiving level is more than threshold L1, and will start the watchdog timer corresponding to the radio terminal B.
[0188]The transmission classification of the data packet which received is "00", and since the destination address of the radio terminal A corresponds with the MAC Address of a local station, it transmits an ACK signal to transmitting agency radio terminal B, and hands over the data packet concerned to the upper layer.
[0189]If this ACK signal is received, the radio terminal B will recognize that the data packet transmission by the transfer-direct method addressed to radio terminal A was successful, and will restart the watchdog timer corresponding to the radio terminal A.
[0190]Next, drawing 20 shows the operating sequence in the case of registering the transmitting agency radio terminal of the data packet into a transfer-direct table in connection with a radio

terminal receiving the data packet transmitted to other addressing to a radio terminal.
[0191]The radio terminal C is registered into the transfer-direct table of the radio terminal A in drawing 20. For this reason, in the radio terminal A, if the data packet which should be transmitted to radio terminal C arises, the radio terminal A will choose the transfer-direct method, will make a destination address the MAC Address of the radio terminal C, will set transmission classification to "00", and will transmit the data packet concerned.
[0192]The radio terminal C will transmit an ACK signal to the transmitting agency radio terminal A, if this data packet is received. It recognizes that the data packet transmission by the transfer-direct method for the radio terminal C finished the radio terminal A with a success by receiving this ACK signal.
[0193]By the way, the data packet of the above-mentioned addressing to radio terminal C may be received by the third party slack radio terminal B.
[0194]In this case, the radio terminal B judges whether a receiving level is more than threshold L1. And when a receiving level is more than threshold L1, the MAC Address of the transmitting agency radio terminal A of the data packet concerned is registered into a transfer-direct table, and the watchdog timer corresponding to the radio terminal A is started. Since it is a thing addressed to radio terminal C, the data packet which received is discarded.
[0195]Next, drawing 21 receives the data packet to which the radio terminal was transmitted by the transfer-direct method, and since the receiving level in that case is less than a threshold, it shows the operating sequence in which a radio terminal erases the registration in the transfer-direct table of the transmitting agency radio terminal of the data packet concerned.
[0196]In drawing 21, the MAC Address of the radio terminal B is registered into the transfer-direct table of the radio terminal A, and the MAC Address of the radio terminal A is registered into the transfer-direct table of the radio terminal B. For this reason, in the radio terminal A, if the data packet which should be transmitted to radio terminal B arises, the radio terminal A will choose the transfer-direct method, will make a destination address the MAC Address of the radio terminal B, will set transmission classification to "00", and will transmit the data packet concerned.
[0197]If this data packet is received, it judges a receiving level, and the radio terminal B will delete the MAC Address of the transmitting agency radio terminal A from a transfer-direct table, when a receiving level is less than [threshold L2], and will stop the watchdog timer corresponding to the radio terminal A.
[0198]The transmission classification of the data packet which received is "00", and since the destination address of the radio terminal B corresponds with the MAC Address of a local station, it transmits an ACK signal to transmitting agency radio terminal A, and hands over the data packet concerned to the upper layer.
[0199]If this ACK signal is received, the radio terminal A will recognize that the data packet transmission by the transfer-direct method addressed to radio terminal B was successful, and will restart the watchdog timer corresponding to the radio terminal B.
[0200]Next, drawing 22 has illustrated the operating sequence when the watchdog timer corresponding to a certain radio terminal becomes time over in a radio terminal.
[0201]The MAC Address of the radio terminal B is registered into the transfer-direct table of the radio terminal A in drawing 22. Therefore, with the radio terminal A, the time check by the watchdog timer corresponding to the radio terminal B is ******. And although the data packet addressed to radio terminal A is transmitted 3 times by the transfer-direct method from the radio terminal B, all end in the example shown in drawing 22 in failure. For this reason, in the radio

terminal A, the watchdog timer corresponding to the radio terminal B serves as time over, and the radio terminal A erases registration of the radio terminal B in a transfer-direct table.
[0202]Then, the data packet which should be transmitted to radio terminal B in the radio terminal A occurs. However, since the radio terminal B is not registered into the transfer-direct table of the radio terminal A at this time, the radio terminal A transmits the data packet addressed to radio terminal B by the relay transfer method.
[0203]In [as explained above] this embodiment, Even if it registers a radio terminal into a transfer-direct table, after that and beyond fixed time. In not receiving the data packet transmitted from the radio terminal concerned and not producing the situation where the transfer direct of the addressing to a radio terminal concerned is successful, either, registration of the radio terminal [in / it is rich and / nothing and a transfer-direct table] concerned which fell into the situation with difficult application of the transfer-direct method by causes, such as movement of the radio terminal concerned, is erased, and the data packet of the addressing to a radio terminal concerned is transmitted by the relay transfer method henceforth.
[0204]As mentioned above, although the characteristic example of this embodiment of operation was explained, about other operations, it is the same as that of operation of 1st and 2nd embodiments of the above that already explained.
[0205]E. A 4th embodiment book embodiment is an embodiment which applied this invention to the radio packet transfer system which consists of a radio terminal which has two kinds of modes, a power save mode and an active mode, and is an embodiment of the invention concerning claim 12.
[0206]Drawing 23 shows the radio packet format delivered and received between the radio terminal and radio terminal in this embodiment, and between a radio terminal and a base transceiver station, drawing 23 (a) is the format of a data packet, and drawing 23 (b) is the format of an ACK signal.
[0207]As shown in drawing 23 (a), the data packet in this embodiment contains the power save mode flag. When setting this power mode flag as "1", transmitting a data packet, when changing to a power save mode, and changing to an active mode, a radio terminal sets this power mode flag as "0", and transmits a data packet.
[0208]A radio terminal notifies beforehand starting of the receiver in a power save mode which can be set working, and the cycle of a stop to a base transceiver station. When the data packet of addressing to a radio terminal which is operating by the power save mode is received, a base transceiver station buffers the data packet concerned, and transmits the data packet concerned to the timing which the receiver of the address radio terminal concerned has started.
[0209]Also in this embodiment, although the data packet by the transfer-direct method can be transmitted from a radio terminal to other radio terminals, When the data packet by the transfer-direct method is transmitted to addressing to a radio terminal which is operating by the power save mode, a possibility of transmission being performed to the timing which the receiver has stopped and becoming transmitting non completion is high. Then, he is trying to also register into a transfer-direct table the power save mode flag of whether the radio terminal concerned besides the MAC Address of the radio terminal in which each radio terminal can apply the transfer-direct method as shown in drawing 24 is working at a power save mode in this embodiment.
[0210]Drawing 25 and drawing 26 are flow charts which show the receiving operation of the data packet of the radio terminal in this embodiment. In most [of receiving operation] most [flows (above-shown drawing 13) and] of a radio terminal in a 2nd embodiment of the above, the

flow of this receiving operation is the same. However, new Step S431B and S432B are added to the flow of above-shown drawing 13 on the relation in which each radio terminal operates not only in an active mode but a power save mode. About other steps, there are not a thing of above-shown drawing 13 and a change. About these, what was used in above-shown drawing 13, and a common thing are used as a number of a step.

[0211]It is as follows when the main point of the receiving operation of the data packet of a radio terminal is explained according to the flow of drawing 25 and drawing 26.

[0212]Transmission classification is "00" or "01", and a radio terminal registers the address of the transmitting agency radio terminal of the data packet concerned into a transfer-direct table, when a receiving level receives the data packet beyond threshold L1 (Step S401, S402, S403, S404, S405).

[0213]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet below threshold L2, Registration of the address of the transmitting agency radio terminal of the data packet concerned in a transfer-direct table is erased (Step S401, S402, S403, S406, S407, S408).

[0214]A radio terminal judges whether the address of the transmitting agency radio terminal of the data packet concerned is registered into the transfer-direct table, when transmission classification receives the data packet which is "00" or "01" (Step S431B). And when the address of the transmitting agency radio terminal is registered, the power mode save flag corresponding to the concerned transmitting former radio terminal registered into the transfer-direct table is updated with the power save mode flag in the data packet concerned. Since such operation is performed in each radio terminal, when a certain radio terminal transmits a data packet, It will be well-known to the information whether the radio terminal concerned is working at a power save mode, to each radio terminal which received the data packet concerned, and it will be registered into the transfer-direct table of each radio terminal.

[0215]The above is the contents of processing of the transfer-direct table relation performed with reception of the data packet by a radio terminal. It is judged whether after finishing these processings, a radio terminal is the transmission classification "00" or the data packet of "10" which the data packet addressed to the local station (Step S409, S410), When this decision result is affirmative, transmission of an ACK signal and delivery to the upper layer of a data packet are performed (Step S412). About the processing after this step S409, there are not a 2nd embodiment of the above and a place which changes in any way.

[0216]Next, drawing 27 is a flow chart which shows the send action of the data packet of the radio terminal in this embodiment. In most [of a send action] most [flows (above-shown drawing 5) and] of a radio terminal in a 1st embodiment of the above, the flow of this send action is the same. However, the new step S231B is added to the flow of above-shown drawing 5 on the relation in which each radio terminal operates not only in an active mode but a power save mode. About other steps, there are not a thing of above-shown drawing 5 and a change. About these, what was used in above-shown drawing 5, and a common thing are used as a number of a step.

[0217]It is as follows when the send action of the data packet of the radio terminal in this embodiment is explained according to the flow of drawing 27. That is, a radio terminal judges whether the address corresponding to the address radio terminal of the data packet concerned is registered into the transfer-direct table, when the data packet which should be transmitted to other radio terminals arises (Step S202). And when the address corresponding to an address radio terminal is registered into the transfer-direct table, the contents of the power save mode flag

corresponding to the address radio terminal are read from a transfer-direct table, and it is judged whether the power save mode flag concerned is "0." And when the power save mode flag operates by "0" and the address radio terminal is operating by the active mode. Transmission of the data packet concerned by the transfer-direct method is tried (Steps S203-S209), and when this goes wrong, transmission by the relay transfer method is performed (Steps S210-S216). On the other hand, transmission by the relay transfer method is performed, without completely trying transmission by the transfer-direct method, when the power save mode flag operates by "1" and the address radio terminal is operating by the power save mode (Steps S210-S216). Since it is the same as what was already explained in a 1st embodiment about the transmission (Steps S203-S209) by the transfer-direct method, and the transmission (Steps S210-S216) by the relay transfer method, explanation here is omitted.

[0218]Since operation in case a base transceiver station relays a data packet in this embodiment is the same as that of the case (refer to above-shown drawing 6) of a 1st embodiment of the above, explanation is omitted.

[0219]Next, drawing 28 and drawing 29 are the operating-sequence figures showing the example of 1 operation of this embodiment. In this example of operation, when the radio terminal A changes from an active mode to a power save mode, it is transmitting the data packet in advance of it. As for this data packet, in order that the transmitting agency radio terminal A may change to the power save mode, the power save mode flag is "1", and transmission classification has become "01." A base transceiver station transmits an ACK signal to radio terminal A, when this data packet is received, and the radio terminal A recognizes a transmitting success of a data packet by reception of this ACK signal.

[0220]In this example of operation, the radio terminal B has received the above-mentioned data packet transmitted from the radio terminal A. Here, the address of the radio terminal A is registered into the transfer-direct table of the radio terminal B. When the receiving level of the data packet concerned is more than threshold L2, the radio terminal B, The power save mode flag corresponding to the transmitting agency radio terminal A of the data packet concerned in a transfer-direct table is updated with the power save mode flag (= "1") contained in the data packet concerned. Since it is not a thing addressed to radio terminal B, the data packet concerned is discarded.

[0221]Then, in the radio terminal B, the data packet which should be transmitted to radio terminal A occurs. In this example of operation, since the MAC Address of the address radio terminal A is registered into the transfer-direct table of the radio terminal B, the radio terminal B judges whether the power mode save flag corresponding to the address radio terminal A registered into the transfer-direct table is "1." In this case, since the power mode flag concerned is "1", the radio terminal B makes a destination address the MAC Address of the radio terminal A, sets transmission classification to "01", and transmits a data packet. A base transceiver station will transmit an ACK signal to transmitting agency radio terminal B, if this data packet is received. The radio terminal B recognizes that transmission of the data packet was successful by reception of this ACK signal.

[0222]Here, the base transceiver station grasps the cycle of starting of the receiver of the radio terminal A, and a stop which recognizes that the radio terminal A is operating by the power save mode, and is operating by the power save mode. Then, a base transceiver station buffers the data packet of addressing to radio terminal A which received from the above-mentioned radio terminal B, and transmits the data packet concerned to the timing which the receiver of the radio terminal A is starting. The radio terminal A will be handed over to the upper layer, if this data

packet is received.
[0223]F. A 5th embodiment book embodiment is an embodiment of the invention concerning claim 13. The format of the radio packet delivered and received in this embodiment between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station is as having been shown in above-shown drawing 23. The receiving operation of the data packet of a radio terminal is the same as that of a 4th embodiment (drawing 25 and drawing 26) of the above.
[0224]The flow of the send action of a data packet which a radio terminal performs in this embodiment is shown in drawing 30 and drawing 31. New step S241 C-S 247C is added to the flow (drawing 27) of a send action [in / in the flow of this send action / a 4th embodiment of the above]. About other steps, when it changes with the thing in a 4th embodiment of the above, there are nothings. About such a step, the same step number as what was used in drawing 27 is used.
[0225]In the case where a transmitting agency radio terminal tends to transmit a data packet to other addressing to a radio terminal, The address radio terminal concerned is registered into the transfer-direct table, and when the power save mode flag of the address radio terminal concerned is "0" (namely, active mode), A transmitting agency radio terminal chooses the transfer-direct method first (Step S201, S202, S231B, S203).
[0226]Next, a transmitting agency radio terminal judges whether the address radio terminal is registered into the authentication success table (Step S241C). Here, the address of the radio terminal which succeeded in the past and attestation is registered into the authentication success table. The operation which registers the address of a radio terminal to an authentication success table is mentioned later.
[0227]When the decision result of the above-mentioned step S241C is "YES", a transmitting agency radio terminal transmits the data packet by the transfer-direct method to an address radio terminal promptly (Steps S204-S209).
[0228]On the other hand, when the decision result of Step S241C is "NO", a radio terminal judges whether the address radio terminal is registered into the attestation refusal table (Step S242C). Here, the address of the radio terminal in which the past and attestation were refused is registered into the attestation refusal table. The operation which registers the address of a radio terminal to an attestation refusal table is mentioned later.
[0229]When the decision result of the above-mentioned step S242C is "YES", a radio terminal performs processing for transmission of the data packet by the relay transfer method (Steps S210-S216).
[0230]On the other hand, when the decision result of the above-mentioned step S242C is "NO", a radio terminal transmits an authentication demand to an address radio terminal (Step S243C). And it judges whether this attestation was successful (Step S244C), when it succeeds in attestation, the address of an address radio terminal is registered into an authentication success table (Step S204), and processing for transmission of the data packet by the transfer-direct method is performed (Steps S204-S209). On the other hand, when it does not succeed in attestation, it is judged whether attestation was refused or not (Step S246C). And when attestation is not refused, a radio terminal performs processing for transmission of the data packet by the relay transfer method (Steps S210-S216). When attestation is refused, after registering the address of an address radio terminal into an attestation refusal table (Step S247C), processing for transmission of the data packet by the relay transfer method is performed (Steps S210-S216).

[0231]Since according to this embodiment packet transfer is performed by the relay transfer method when not succeeding in attestation, the situation where the packet which performed transfer direct to the unattested address radio terminal is discarded by the address radio terminal side is avoidable. According to this embodiment, the past and the radio terminal with which attestation was successful are received, Attestation can be omitted, data packet transmission by the transfer-direct method can be performed, and there is an advantage that the data packet by the relay transfer method can be transmitted, without performing procedure for useless attestation to the past and the radio terminal in which attestation was refused.
[0232]Drawing 32 and drawing 33 are the operating-sequence figures showing the example of this embodiment of operation respectively. Hereafter, with reference to these figures, operation of this embodiment is explained still more concretely.
[0233]First, in the example of operation shown in drawing 32, the MAC Address of the address radio terminal B is registered into the transfer-direct table of the radio terminal A, and attestation is not performed between the radio terminal A and the radio terminal B, and attestation is not refused.
[0234]For this reason, if the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A will send an authentication demand to the radio terminal B. When attesting, the radio terminal B sends the notice of an authentication result of a purport which permits attestation to the radio terminal A, and registers the address of the radio terminal A into an attestation permission table.
[0235]The radio terminal A will register the address of the radio terminal B into an attestation permission table, if the above-mentioned notice of an authentication result is received.
[0236]Then, when the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A omits attestation and transmits the data packet by the transfer-direct method to radio terminal B.
[0237]If this data packet is received, the that transmitting former radio terminal A judges whether it is the radio terminal registered into the attestation permission table, and the radio terminal B will transmit an ACK signal to the addressing concerned to radio terminal A, when a decision result is "YES", and will hand over the data packet concerned to the upper layer.
[0238]The radio terminal A recognizes that transmission of the data packet was successful by receiving the ACK signal from the radio terminal B.
[0239]Next, the example of operation shown in drawing 33 is explained. In this example of operation, the MAC Address of the address radio terminal B is registered into the transfer-direct table of the radio terminal A, and attestation is not performed between the radio terminal A and the radio terminal B, and attestation is not refused.
[0240]For this reason, if the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A will send an authentication demand to the radio terminal B. However, the radio terminal B in this example of operation sends the notice of an authentication result of a purport which refuses attestation to the radio terminal A.
[0241]The radio terminal A will register the address of the radio terminal B into an attestation refusal table, if the above-mentioned notice of an authentication result is received.
[0242]Then, when the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A transmits the data packet by the relay transfer method to radio terminal B, without attesting.
[0243]That is, the radio terminal A makes a destination address the MAC Address of the radio terminal B, sets transmission classification to "01", and transmits a data packet. A base

transceiver station will transmit an ACK signal to transmitting agency radio terminal A, if this data packet is received. The radio terminal A recognizes a transmitting success of a data packet by receiving this ACK signal. A base transceiver station sets transmission classification to "10", and transmits the above-mentioned data packet from the radio terminal A. The radio terminal B will be handed over to the upper layer, if this data packet is received.

[0244]The above is a characteristic example of operation in this embodiment. When a radio terminal erases registration of the radio terminal registered into the transfer-direct table in this embodiment, registration cancellation of the radio terminal concerned in an authentication success table or an attestation refusal table is not performed. Therefore, even when the obstacle between radio terminals moves frequently, for example and registration of a transfer-direct table and registration cancellation arise frequently, the register state of an authentication success table or an attestation refusal table does not change with these. For this reason, if the past and attestation were successful when registration to a transfer-direct table was again performed about the radio terminal concerned after registration cancellation in a transfer-direct table was performed about a certain radio terminal, Transfer direct can be performed to the radio terminal concerned, without attesting in piles. The management is needed when it is expected to an authentication success table or an attestation refusal table that a huge number of radio terminals are registered. In this case, when the total of registered radio terminals, such as an authentication success table, is likely to exceed for example, the maximum number of registration, for example, it may be made to erase registration of the oldest thing.

[0245]G. In the 6th embodiment radio packet transfer system, broadcasting which transmits a data packet for an identical content from a radio terminal all at once to other radio terminals of all the may be performed. This embodiment applies this invention to the radio packet transfer system with which such broadcasting is performed, and is an embodiment of the invention concerning claim 14. The format of the radio packet delivered and received between a radio terminal and a base transceiver station in this embodiment is as having been shown in above-shown drawing 23.

[0246]The flow of the receiving operation of a data packet which a radio terminal performs in this embodiment is shown in drawing 34 and drawing 35. The flow of this send action is that to which the new step S451D was added to the flow (drawing 25 and drawing 26) of the send action in a 4th embodiment of the above. About other steps, when it changes with the thing in a 4th embodiment of the above, there are nothings. About such a step, the same step number as what was used in drawing 25 and drawing 26 is used.

[0247]Although it judges whether the destination address of a radio terminal of the data packet which received corresponds with the address of a local station in Step S409 in this embodiment, When this decision result is "NO", it is judged whether the data packet concerned is a broadcasting packet (Step S451D). And when the data packet concerned is a broadcasting packet, the data packet concerned is handed over to the upper layer (Step S412), and in not being a broadcasting packet, it discards the data packet concerned (Step S413). About other operations, there are not a 4th embodiment of the above and a place which changes in any way.

[0248]Next, the flow of the send action of a data packet which a radio terminal performs in this embodiment is shown in drawing 36 and drawing 37. The flow of this send action is that to which the new step S251D was added to the flow (drawing 30 and drawing 31) of the send action in a 5th embodiment of the above. About other steps, there are not a thing in a 5th embodiment of the above and a changing place. About such a step, the same step number as what was used in drawing 30 and drawing 31 is used.

[0249]When a radio terminal tends to transmit a data packet in this embodiment, it is judged whether the transmission is performed as broadcasting (Step S251D). And when this decision result is "NO", it progresses to Step S201 and the completely same processing as a 5th embodiment of the above is performed henceforth. On the other hand, when the decision result of Step S251D is "YES", broadcasting of the data packet concerned is performed by the relay transfer method (Steps S210-S216).
[0250]Drawing 38 is an operating-sequence figure showing the example of concrete operation of this embodiment. As shown in this drawing 38, when transmitting a data packet by broadcasting, the radio terminal A sets transmission classification to "01", makes a destination address the information corresponding to broadcasting, and transmits the data packet concerned. It sets transmission classification to "10" and transmits the data packet concerned while returning an ACK signal, if a base transceiver station is received [this data packet]. If this data packet is received, all the radio terminals accommodated in the base transceiver station concerned will recognize that the data packet concerned is a broadcasting packet, and will hand it over to the upper layer.
[0251]H. A 7th embodiment book embodiment is an embodiment of the invention which enables it to perform data packet transmission to a desired radio terminal by the transfer-direct method when a radio terminal is in the service outside of the circle of a base transceiver station, and relates to claim 15. Below, this embodiment explains to an example the case where it applies to a 6th embodiment of the above, although it is also possible to apply to any of each already described embodiment.
[0252]In this embodiment, a base transceiver station transmits a reporting signal periodically. It is judged that a radio terminal has a local station in the service outside of the circle of the base transceiver station concerned when it judges that the local station is in the service within the circle of the base transceiver station concerned when this reporting signal is received correctly, and it does not receive correctly.
[0253]The operation flow of the send action of a data packet which a radio terminal performs in this embodiment is shown in drawing 39 and drawing 40. The flow of this send action is that to which the new step S261E was added to the flow (drawing 36 and drawing 37) of the send action in a 6th embodiment of the above. About other steps, there are not a thing in a 6th embodiment of the above and a changing place. About such a step, the same step number as what was used in drawing 36 and drawing 37 is used.
[0254]When a radio terminal tends to transmit a data packet in this embodiment, it is judged whether the local station is in the service within the circle of a base transceiver station (Step S261E).
[0255]And when a local station is in the service outside of the circle (when the decision result of Step S261E is "NO"), a local station is in a service within the circle, And when the address radio terminal is registered into the transfer-direct table, the data packet transmission to the address radio terminal by the transfer-direct method is tried (Steps S203-S20). (when the decision result of Step S261E and Step S202 is "YES")
[0256]When a local station is in a service within the circle and the address radio terminal is not registered into a transfer-direct table on the other hand (the decision result of Step S261E is "YES", and) And when the decision result of Step S202 is "NO", data packet transmission to the address radio terminal by the relay transfer method is performed (Steps S210-S216). About other points, it is the same as that of a 6th embodiment of the above.
[0257]I. An 8th embodiment book embodiment gives facilities in case a radio terminal changes a

base transceiver station (hand-off), and is an embodiment of the invention concerning claim 16. This embodiment can also be applied to any of each already described embodiment.
[0258]Drawing 41 is a flow chart which shows operation in case a radio terminal performs a hand-off in this embodiment. As shown in this figure, a radio terminal will choose the base transceiver station which is a new in-zone state place, if a hand-off is started (Step S501). Here, as an opportunity of a hand-off start, the case where the reporting signal from a base transceiver station is not received, for example as for j continuation can be set up. As a selection method of a new in-zone state place base transceiver station, the total radio-channel frequency in fixed time and a radio packet transfer system can be monitored, and the method of choosing the base transceiver station where the receiving level of the above-mentioned reporting signal is the largest can be taken, for example. Subsequently, a radio terminal erases registration of all the radio terminals in a transfer-direct table (Step S502).
[0259]the case where the radio terminal is carrying out other radio terminals and transfer direct in front of the hand-off according to this embodiment -- after a hand-off -- the relay transfer method -- being concerned -- others -- packet transfer addressed to a radio terminal will be performed.
[0260]J. A 9th embodiment book embodiment applies this invention to the radio packet transfer system which performs packet transfer by the fragmentation division transmission method, and is an embodiment of the invention concerning claim 17. This embodiment can also be applied to any of each already described embodiment.
[0261]The operation flow of the send action of a data packet which a radio terminal performs to drawing 42 in this embodiment is shown. A radio terminal determines whether to transmit the data packet concerned by the transfer-direct method, or transmit by the relay transfer method at the time of transmission of a data packet (Step S601). It is as having already explained the concrete processing for determining this transfer method in each embodiment.
[0262]And when transmitting a data packet by the transfer-direct method, a radio terminal, The data packet concerned is divided so that packet length may become below in the fragmentation threshold concerned, when judging whether it is over the fragmentation threshold in case the packet length of the data packet concerned is transfer direct (Step S602), and having exceeded (Step S603).
[0263]When transmitting a data packet by the relay transfer method, on the other hand, a radio terminal, The data packet concerned is divided so that packet length may become below in the fragmentation threshold concerned, when judging whether it is over the fragmentation threshold in case the packet length of the data packet concerned is relay transfer (Step S604), and having exceeded (Step S605).
[0264]After passing through the above processing, when based on the transfer-direct method, transmission classification of a data packet is set to "00", when based on the relay transfer method, transmission classification of a data packet is set to "01", and a data packet is transmitted (Step S606).
[0265]It is as having already explained concrete processing of the transfer-direct method and the relay transfer method in each embodiment.
[0266]According to this embodiment, the fragmentation threshold for transfer direct is set as a value suitable for the transmission line between radio terminals, And the fragmentation threshold for relay transfer can be set as a value suitable for the transmission line between a radio terminal and a base transceiver station, and, thereby, a high throughput can be obtained.
[0267]K. A 10th embodiment book embodiment applies this invention to the radio packet

transfer system which performs packet transfer with a RTS/CTS random access method, and is an embodiment of the invention concerning claim 18. This embodiment can also be applied to any of each already described embodiment.

[0268]The operating sequence of the data packet transmission by a RTS/CTS random access method is shown in drawing 43. In drawing 43, the transmitting agency radio terminal A gives a transmission source address and packet length to an RTS signal. And in performing transmission by the relay transfer method, transmission classification "01" is given to an RTS signal and it transmits to a base transceiver station, and in performing transmission by the transfer-direct method, transmission classification "00" is given to an RTS signal and it transmits to an address radio terminal. In the example of operation shown in drawing 43, the radio terminal A gave transmission classification "00" to the RTS signal, and has transmitted to radio terminal B so that it may perform transmission by the transfer-direct method.

[0269]The radio terminal B will transmit the CTS signal having contained the packet length which made the permission address the address of the transmitting agency radio terminal A of an RTS signal, and was given to the RTS signal, if transmission classification receives the RTS signal which is "00." Also when a base transceiver station receives the RTS signal whose transmission classification is "01", the same CTS signal is transmitted by the base transceiver station concerned.

[0270]Each radio terminal will judge whether the permission address of the CTS signal concerned is in agreement with the address of a local station, if the above-mentioned CTS signal is received.

[0271]In the example shown in drawing 43, the radio terminal A which is transmitting [the above-mentioned RTS signal] origin will transmit the data packet of addressing to radio terminal B which sets transmission classification to "00", if it checks that the permission address of a CTS signal is in agreement with the address of a local station. The radio terminal B will transmit an ACK signal to radio terminal A, if this data packet is received. The radio terminal A recognizes a transmitting success by receiving this ACK signal.

[0272]On the other hand, since the permission address of other radio terminals C of the above-mentioned CTS signal does not correspond with the address of a local station, transmission of the period equivalent to the packet length contained in a CTS signal, a data packet, and an RTS signal is not performed.

[0273]The above is an outline of operation of the data packet transmission by a RTS/CTS random access method. according to this method -- what is called -- it can hide and the problem of a terminal can be solved.

[0274]Drawing 44 is a flow chart which shows the send action of the data packet of the radio terminal in this embodiment. If the data packet which should be transmitted produces a radio terminal in this embodiment, after setting a retry counter as "1" (Step S701), it will determine whether to perform data packet transmission by the transfer-direct method, or carry out by the relay transfer method (Step S702).

[0275]When performing data packet transmission by the transfer-direct method is determined, It judges whether the packet length of the data packet concerned is over the RTS threshold for transfer direct (Step S703), when this decision result is "YES", it progresses to Step S705, and in "NO", it progresses to Step S710. When performing data packet transmission by the relay transfer method is determined on the other hand, It judges whether the packet length of the data packet concerned is over the RTS threshold for relay transfer (Step S704), when this decision result is "YES", it progresses to Step S705, and in "NO", it progresses to Step S710.

[0276]Next, packet length is over the RTS threshold for transfer direct, or the RTS threshold for relay transfer, and if it progresses to Step S705 from Step S703 or S704, a radio terminal will transmit an RTS signal. Here, in the case of transfer direct, transmission classification "00" is given to an RTS signal, it transmits, in the case of relay transfer, transmission classification "01" is given to an RTS signal, and it transmits.
[0277]After finishing transmission of this RTS signal, it is judged whether the CTS signal was received (Step S706). And when not receiving a CTS signal, judge whether the value of a retry counter is less than the predetermined value K (Step S707), and in being less than K. While only the time on which it decides at random stands by, only "1" makes a retry counter increase (Step S708), and transmission (Step S705) of an RTS signal is repeated again. Even if it is a case where a CTS signal is received, it is also fundamentally the same as when the permission address included in that CTS signal is not in agreement with the address of a local station, but (Step S709) only time to be equivalent to the packet length contained in a CTS signal in this case postpones transmission of an RTS signal.
[0278]When the destination address which receives a CTS signal after transmission of the above-mentioned RTS signal, and is included in a CTS signal is in agreement with the address of a local station, A data packet is transmitted with the transfer method determined in Step S702 among the transfer-direct method or the relay transfer method (Step S710).
[0279]A data packet is discarded when the value of a retry counter reaches the predetermined value K, without receiving the CTS signal addressed to a local station (Step S711).
[0280]The above is a send action of the data packet of the radio terminal in this embodiment. Since the RTS threshold is set [according to this embodiment] aside the case of transfer direct, and in the case of relay transfer, A high throughput can be obtained by making the RTS threshold for transfer direct into a value suitable for the transmission line between radio terminals, and making the RTS threshold for relay transfer into a value suitable for the transmission line between a radio terminal and a base transceiver station.
[0281]
[Effect of the Invention](1) According to the invention concerning claims 1-16, a possibility that the packet transfer by the transfer-direct method will end in failure is low, The packet transfer according to the transfer-direct method as much as possible on the other hand can be performed, a high throughput is obtained and the effect that packet transfer can be performed by the shortest possible transfer time is acquired.
[0282](2) According to the invention concerning claim 12, though it obtained with the address radio terminals concerned and registered with the transfer-direct table while the address radio terminal was operating by the power save mode, the relay transfer method is applied. Therefore, according to this invention, the situation where the packet transfer by the transfer-direct method goes wrong by carrying out at the address radio terminal which is operating by the power save mode can be avoided, and the effect that improvement in a throughput can be aimed at is acquired.
[0283](3) The problem that it will be discarded by the address radio terminal side if according to the invention concerning claim 13 a packet is transmitted by the transfer-direct method when an address radio terminal refuses attestation is solved, A high throughput is obtained by this and the effect that packet transfer can be performed by the shortest possible packet transfer time is acquired.
[0284](4) According to the invention concerning claim 14, when transfer direct is performed, relay transfer can perform packet transfer also to the radio terminal which cannot receive a

broadcasting packet, and the effect that reliability can be improved is acquired in packet transfer.
[0285](5) When a radio terminal is located in the outside of the circle of the service area of a base transceiver station according to the invention concerning claim 15, Since a packet is transmitted by the transfer-direct method irrespective of whether the address radio terminal is registered into the transfer-direct table, the useless packet transfer by the relay transfer method can be prevented, and the effect that improvement in a throughput and shortening of packet transfer time can be aimed at is acquired.
[0286](6) According to the invention concerning claim 16, after the change of a base transceiver station, First, since packet transfer is performed by the relay transfer method, generating of the situation of transfer direct after the change of a base transceiver station being performed, and failing is prevented, and the effect that improvement in a throughput and shortening of packet transfer time can be aimed at is acquired.
[0287](7) According to the invention concerning claim 17, since the fragmentation threshold which was suitable for each the case of the relay transfer method and in the case of the transfer-direct method can be used, the effect that improvement in a throughput can be aimed at is acquired.
[0288](8) According to the invention concerning claim 18, since the RTS threshold which was suitable for each the case of the relay transfer method and in the case of the transfer-direct method can be used, the effect that improvement in a throughput can be aimed at is acquired.

TECHNICAL FIELD

[Field of the Invention]This invention relates to the radio packet transfer method in wireless packet communication.

PRIOR ART

[Description of the Prior Art]Conventionally, this kind of radio packet transfer methods included the following.
[0003](1) Range LAN2 automatic-switching method Range LAN2 are the wireless LAN products of a 2.4GHz bandwidth. Packet transfer is performed in this Range LAN2, using selectively the transfer-direct method that the relay transfer method that a transmitting agency radio terminal transmits a packet to an address radio terminal via a base transceiver station, or a transmitting agency radio terminal transmits a packet to an address radio terminal directly. It is automatically changed by the transmitting agency radio terminal side any shall perform packet transfer between the relay transfer method and the transfer-direct method in this case. It is as follows when it furthermore explains in full detail.
[0004]The radio terminal of a transmitting agency carries out transfer direct of the packet concerned to the address radio terminal concerned by the transfer-direct method first, when the packet which should be transmitted to other addressing to a radio terminal arises. Then, a transmitting agency radio terminal resends a packet, when not receiving the reply signal from an address radio terminal within fixed time. And even if a transmitting agency radio terminal transmits a packet 3 times, when not receiving a reply signal, it changes the method of packet transfer for the address radio terminal concerned to the relay transfer method. Henceforth, a transmitting agency radio terminal changes again the method of packet transfer for the address radio terminal concerned to the transfer-direct method, when a packet is transmitted by the relay

transfer method, fixed time continuation is carried out to the address radio terminal concerned and packet transfer is not performed between the address radio terminals concerned.
[0005](2) Decision of the standards of wireless LAN is advanced in the fragmentation division transmission method IEEE802.11 committee. And the fragmentation division transmission method is supported in the standards proposal upon which it was decided in the committee. In this fragmentation division transmission method, when exceeding the threshold (fragmentation threshold) as which the packet concerned was beforehand determined when a radio terminal transmitted a packet, the packet concerned is divided and it transmits so that packet length may become below in this fragmentation threshold. As a reference relevant to this art, There is "IEEE P202.11,Draft Standard For Wireless LAN Medium Access Control(MAC) and Physical Layer (PHY) Specification, D6.1."
[0006](3) In the standards proposal of the wireless LAN upon which it was decided in the RTS/CTS random access method above-mentioned IEEE802.11 committee, the RTS/CTS random access method besides the above-mentioned fragmentation division transmission method is supported.
[0007]In this RTS/CTS random access method. When a radio terminal transmits a packet and the packet length of the packet concerned exceeds the threshold (RTS threshold) defined beforehand, The identifier (transmission source address) and packet length of a transmitting agency radio terminal are given to the RTS (Request To Send) signal for requiring a request to print out files of a radio channel, and it transmits to an address radio terminal or a base transceiver station.
[0008]If this RTS signal is received, in order to permit the reservation request of a radio channel and to report this to other radio terminals or base transceiver stations, an address radio terminal or a base transceiver station, The transmission source address of an RTS signal is made into a permission address, and it gives and transmits to a CTS (Clear To Send) signal by making packet length into a reservation period.
[0009]It is judged whether if this CTS signal is received, the permission address shown by a CTS signal and the address of the transmitting agency radio terminal which transmitted the RTS signal of the concerned transmitting former radio terminal correspond. And transmission of a packet and an RTS signal is not performed until a reservation period expires, when not in agreement [when both addresses are in agreement, a packet is transmitted, and].
[0010]after a receiver reports a request to print out files of a radio channel with a CTS signal according to this method, in order that the transmitting side may transmit a packet -- what is called -- it can hide and the problem of a terminal can be solved. As a reference about this method, "IEEE which already mentioned. There is P202.11,Draft Standard For Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, D6.1."

EFFECT OF THE INVENTION

[Effect of the Invention](1) According to the invention concerning claims 1-16, a possibility that the packet transfer by the transfer-direct method will end in failure is low, The packet transfer according to the transfer-direct method as much as possible on the other hand can be performed, a high throughput is obtained and the effect that packet transfer can be performed by the shortest possible transfer time is acquired.
[0282](2) According to the invention concerning claim 12, though it obtained with the address radio terminals concerned and registered with the transfer-direct table while the address radio terminal was operating by the power save mode, the relay transfer method is applied. Therefore,

according to this invention, the situation where the packet transfer by the transfer-direct method goes wrong by carrying out at the address radio terminal which is operating by the power save mode can be avoided, and the effect that improvement in a throughput can be aimed at is acquired.
[0283](3) The problem that it will be discarded by the address radio terminal side if according to the invention concerning claim 13 a packet is transmitted by the transfer-direct method when an address radio terminal refuses attestation is solved, A high throughput is obtained by this and the effect that packet transfer can be performed by the shortest possible packet transfer time is acquired.
[0284](4) According to the invention concerning claim 14, when transfer direct is performed, relay transfer can perform packet transfer also to the radio terminal which cannot receive a broadcasting packet, and the effect that reliability can be improved is acquired in packet transfer.
[0285](5) When a radio terminal is located in the outside of the circle of the service area of a base transceiver station according to the invention concerning claim 15, Since a packet is transmitted by the transfer-direct method irrespective of whether the address radio terminal is registered into the transfer-direct table, the useless packet transfer by the relay transfer method can be prevented, and the effect that improvement in a throughput and shortening of packet transfer time can be aimed at is acquired.
[0286](6) According to the invention concerning claim 16, after the change of a base transceiver station, First, since packet transfer is performed by the relay transfer method, generating of the situation of transfer direct after the change of a base transceiver station being performed, and failing is prevented, and the effect that improvement in a throughput and shortening of packet transfer time can be aimed at is acquired.
[0287](7) According to the invention concerning claim 17, since the fragmentation threshold which was suitable for each the case of the relay transfer method and in the case of the transfer-direct method can be used, the effect that improvement in a throughput can be aimed at is acquired.
[0288](8) According to the invention concerning claim 18, since the RTS threshold which was suitable for each the case of the relay transfer method and in the case of the transfer-direct method can be used, the effect that improvement in a throughput can be aimed at is acquired.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]By the way, the following problems were among each conventional technology mentioned above.
[0012](1) The problem of the Range LAN2 automatic-switching method [0013]** When two sets of the radio terminals which cannot perform transfer direct perform packet transfer, the increase in the time required until packet transfer is completed, and degradation of the throughput of the radio packet whole system arise.
[0014]For example, drawing 45 shows an example of the situation which such a problem produces. In the example shown in this drawing 45, the shelter S intervenes between the radio terminal a and the radio terminal b, and both cannot do transfer direct. In such a case, if it shall set, for example, the radio terminal a shall transmit a packet to radio terminal b in accordance with the Range LAN2 automatic-switching method, Since the radio terminal a will change to the relay transfer method which went via the base transceiver station 10 after trying the packet transfer by the transfer-direct method 3 times, the time required until packet transfer is

eventually successful will become long. Since three packet transfer is performed by the transfer-direct method, radio-channel resources are consumed vainly and the problem that the throughput of the radio packet whole system deteriorates arises. A base transceiver station produces each above problem also in the network composition connected to the cable packet network. In this case, the radio terminal which is in the service area of a base transceiver station cannot perform a wired terminal and transfer direct. However, if the Range LAN2 automatic-switching method shall be followed, Even in such a case, the problem of degradation of the increase in the time required of packet transfer and the throughput of the radio packet whole system produces it in order to perform the change to the relay transfer method, after a radio terminal tries transfer direct 3 times to a wired terminal.

[0015]** If the change to the relay transfer method from the transfer-direct method is once performed, even if an address radio terminal will move to the position in which transfer direct is possible for a transmitting agency radio terminal after that, Unless communication between a transmitting agency radio terminal and an address radio terminal stops continuously beyond fixed time, the change to the transfer-direct method is not performed. Therefore, the radio terminals in which transfer direct is originally possible will communicate vainly using a base transceiver station, and there is a problem of causing the increase in the packet transfer time by going via a base transceiver station and decline in the transfer efficiency by consumption of radio-channel resources.

[0016]** While the problem radio terminal relevant to a power save mode is operating by the power save mode which repeats starting and a stop of a receiver periodically, a packet may be transmitted to the addressing to a radio terminal concerned. When a packet is transmitted to the radio terminal concerned in the period which has a receiver of a radio terminal at a halt condition in this case, reception of a packet is not performed, but a radio channel is vainly consumed as a result, and there is a problem that degradation of the throughput of the radio packet whole system arises.

[0017]** When the problem Range LAN2 automatic-switching method relevant to attestation of the radio terminal shall be followed, it may happen that a radio terminal transmits a packet to other radio terminals which refused attestation by the transfer-direct method. In this case, since a packet will be discarded by the radio terminal side which refused attestation, a radio channel is vainly consumed as a result and there is a problem that degradation of the throughput of the radio packet whole system arises.

[0018]** Broadcasting which transmits the same packet all at once to the radio terminal of problem plurality in the case of broadcasting may be performed. If the above-mentioned Range LAN2 automatic-switching method shall be applied to the radio packet system by which this broadcasting is performed, Since the packet (broadcasting packet) which is an object of broadcasting will be first transmitted to each radio terminal by the transfer-direct method, The radio terminal which carries out the whereabouts to the position which cannot see and carry out transfer direct from a transmitting agency radio terminal has the problem that a broadcasting packet is unreceivable.

[0019]** A problem radio terminal in case the change of a base transceiver station arises may move, and the base transceiver station which is an in-zone state place may change. In this case, the radio terminal which was performing packet transfer by the transfer-direct method to a certain address radio terminal before movement will perform packet transfer by the transfer-direct method to the same address radio terminal after movement. However, the packet transfer by the transfer-direct method may become difficult between address radio terminals by the

change of a base transceiver station,In that case, transfer direct ends in failure, radio-channel resources are consumed vainly, and there is a problem that the throughput of the whole radio packet transfer system deteriorates. When the channel frequency used for communication with the change of a base transceiver station changes, When a packet is transmitted by the transfer-direct method with new channel frequency after a change to the address radio terminal which had transmitted the packet by the transfer-direct method before a change, it may end in failure. Also in this case, radio-channel resources are consumed vainly, and there is a problem that the throughput of the whole radio packet transfer system deteriorates.
[0020](2) The probability that a packet error will arise in a radio transmission line becomes high as packet length becomes long in radio packet transmission at the general problem of the fragmentation division transmission method. Since according to the fragmentation split method it transmits after dividing about the packet exceeding a fragmentation threshold so that packet length may become below a fragmentation threshold, this problem is solvable.
[0021]However, since a header is given to each packet after division when dividing a packet and transmitting, it becomes a factor in which a throughput deteriorates.
[0022]Therefore, in consideration of the error rate in the radio transmission line of the radio packet transfer system which serves as the object in applying the fragmentation division transmission method, when an error rate is large, a fragmentation threshold is made small, and when an error rate is small, to enlarge a fragmentation threshold is desired.
[0023]By the way, in a radio packet transfer system, a base transceiver station is installed in the position which can generally keep seeing Hitoshi Amai's radio terminal. On the other hand, a radio terminal is used in desk superiors and a chiefly low position. Therefore, the transmission line between radio terminals has a large error rate compared with the transmission line between a radio terminal and a base transceiver station.
[0024]Therefore, in the radio packet transfer system with which a radio terminal changes and uses the relay transfer method and the transfer-direct method, When a fragmentation threshold is made into a value suitable for the transmission line between a radio terminal and a base transceiver station, a packet error rate becomes large at the time of the packet transfer by the transfer-direct method, and there is a problem that a throughput falls. Conversely, when a fragmentation threshold is made into a value suitable for the transmission line between radio terminals, there is a problem that a throughput falls by the overhead by packet division at the time of the packet transfer by the relay transfer method.
[0025](3) since according to the problem RTS/CTS random access method of a RTS/CTS random access method a receiving station transmits a CTS signal and a request to print out files of a radio transmission line is declared -- what is called -- it can hide, a terminal problem can be solved and a throughput can be improved. However, in the case of this method, an RTS signal and a CTS signal need to be delivered and received, and the overhead by this causes throughput degradation.
[0026]Therefore, in applying a RTS/CTS random access method. The probability of hiding in the radio packet transfer system used as the object, and being generated by the terminal is taken into consideration, When the probability of making an RTS threshold small, hiding and preventing the influence by a terminal when the probability of hiding and being generated by the terminal is large, and hiding and being generated by the terminal is small, the overhead which enlarges an RTS threshold and is applied to transfer of an RTS signal and a CTS signal is controlled, and to raise a throughput is desired.
[0027]By the way, as mentioned above, a base transceiver station is installed in the position

which can generally keep seeing Hitoshi Amai's radio terminal, and a radio terminal is used in desk superiors and a chiefly low position. Therefore, the transmission line between radio terminals has the high probability that is easy to be influenced by a radio-shielding thing compared with the transmission line between a radio terminal and a base transceiver station, and will hide and a terminal will arise.

[0028]Therefore, in the radio packet transfer system with which a radio terminal changes and uses the relay transfer method and the transfer-direct method, When an RTS threshold is made into a value suitable for the transmission line between a radio terminal and a base transceiver station, it hides at the time of the packet transfer by the transfer-direct method, and becomes easy to produce a terminal, and there is a problem that a throughput falls. Conversely, when an RTS threshold is made into a value suitable for the transmission line between radio terminals, there is a problem that a throughput falls by the overhead which takes for transfer of an RTS signal and a CTS signal at the time of the packet transfer by the relay transfer method.

[0029]They are many problems which each conventional technology which the above mentioned above has.

[0030]This invention is made in view of the above situation, and that 1st purpose has a low possibility that the packet transfer by the transfer-direct method will end in failure, and there is in providing the radio packet transfer method which can perform that packet transfer according to the transfer-direct method as much as possible on the other hand.

[0031]The 2nd purpose of this invention solves the problem that it will not be received if packet transfer by the transfer-direct method is performed while the address radio terminal is operating by the power save mode, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.

[0032]The 3rd purpose of this invention solves the problem that it will be discarded by the address radio terminal side if an address radio terminal transmits a packet by the transfer-direct method when attestation is not successful, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.

[0033]When the 4th purpose of this invention transmits a broadcasting packet by the transfer-direct method, The radio terminal which has not carried out the whereabouts to the position in which transfer direct is possible solves the problem that a broadcasting packet is unreceivable, and it is in providing the radio packet transfer method which can transmit a broadcasting packet with high reliability.

[0034]In the case where the transmitting agency radio terminal to which the 5th purpose of this invention is performing packet transfer by the transfer-direct method to a certain address radio terminal changes a base transceiver station, If the concerned transmitting former radio terminal changes and packet transfer is performed by the transfer-direct method to the same address radio terminal as a front, transmission will solve the problem that it may end in failure, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.

[0035]The 6th purpose of this invention solves the problem of degradation of the improvement effect of the throughput at the time of applying a fragmentation split method, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.

[0036]The 7th purpose of this invention solves the problem of degradation of the improvement

effect of the throughput at the time of applying a RTS/CTS random access method, It is in providing the radio packet transfer method which a high throughput is obtained and can perform packet transfer by the shortest possible packet transfer time.
* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem]It is aimed only at a high radio terminal by possibility that packet transfer by a transfer-direct method will be successful in order to attain the 1st purpose of the above, Packet transfer by a transfer-direct method is performed, and a means to except from an applied object of a transfer-direct method beforehand is desired about a radio terminal in which packet transfer by a transfer-direct method may fail.
[0038]Generally, since a radio terminal is what can move, even if transfer direct performed to an address radio terminal at a certain time is successful, when after that is another, transfer direct performed to the same address radio terminal is not necessarily successful. On the contrary, even if transfer direct performed to an address radio terminal at a certain time goes wrong, when after that is another, transfer direct performed to the same address radio terminal may be successful. That is, a radio terminal with a high possibility that packet transfer by a transfer-direct method will be successful was not fixed.
[0039]Therefore, when a possibility that packet transfer according [a certain radio terminal] to a transfer-direct method will be successful becomes a high radio terminal, this is promptly included in an applied object of a transfer-direct method, When a possibility that packet transfer according [a certain radio terminal] to a transfer-direct method will go wrong becomes a high radio terminal, a certain means to except this from an applied object of a transfer-direct method promptly is desired.
[0040]An invention concerning claim 1 is made according to such an idea, When a radio terminal addresses to other radio terminals and transmits a packet, the concerned transmitting former radio terminal transmits a packet to a base transceiver station, A relay transfer method that the base transceiver station concerned transmits the packet concerned to the address radio terminal concerned, Or the concerned transmitting former radio terminal chooses either of transfer-direct methods which transmit the packet concerned to the address radio terminal concerned directly, Transmit the packet concerned by a selected method, said address radio terminal and said base transceiver station transmit, when said packet is received without an error, and a reply signal a said transmitting former radio terminal, When said reply signal is received within after-transmission fixed time of said packet, it is judged as packet transmission completion, In a radio packet transfer method which judges it as packet transmission non completion, and resends the packet concerned in not receiving said reply signal within after-transmission fixed time of said packet, said radio terminal -- a. -- memorizing a transfer-direct

table which specifies a radio terminal which can apply said transfer-direct method -- b., when transmitting a packet to other arbitrary addressing to a radio terminal, When the address radio terminal concerned is not registered into said transfer-direct table, a packet is transmitted by said relay transfer method, When the address radio terminal concerned is registered into said transfer-direct table, a packet is transmitted by said transfer-direct method, c. Based on a receiving condition in a local station of a packet transmitted to arbitrary addressing to a radio terminal, It is judged whether a registration condition for a transmitting agency radio terminal of the packet concerned to be registered into said transfer-direct table is fulfilled, When fulfilling the registration condition concerned, the concerned transmitting former radio terminal is registered into said transfer-direct table, d. At least based on one side of a receiving condition when a local station receives a packet which transmitted to the addressing to a radio terminal concerned from a transmission result or arbitrary radio terminals when a local station transmits a packet to addressing to a radio terminal registered into said transfer-direct table, It judges whether registration cancellation conditions for erasing registration of the radio terminal concerned in said transfer-direct table are fulfilled, and when you fulfill the registration cancellation conditions concerned, let a radio packet transfer method erasing registration of the radio terminal concerned in said transfer-direct table be a gist.

[0041]According to this invention, only a high radio terminal of a possibility of succeeding when packet transfer by a transfer-direct method is performed can be registered into a transfer-direct table, and packet transfer by a transfer-direct method can be tried only for this registered radio terminal.

[0042]In this invention, it is judged based on "a receiving condition in a local station of a packet transmitted to arbitrary addressing to a radio terminal" in whether it is "a high radio terminal of a possibility of succeeding when packet transfer is performed" from the radio terminal concerned. That is, also when a receiving condition in a local station of a packet transmitted from a certain radio terminal is good, and a packet is transmitted to the radio terminal concerned by a transfer-direct method from a local station, at the radio terminal side concerned, reception of a packet should be performed by a good receiving condition. Then, when a receiving condition of a packet is good, it judges with a transmitting agency radio terminal of the packet concerned filling the above "registration condition", and it registers with a transfer-direct table.

[0043]About by what a "receiving condition" presupposes that it is good, although various standards can be considered, it is mentioned, for example that a receiving level of a packet is sufficiently large, that frequency where reception is performed with sufficient receiving level is high, that an error rate of received data is low, etc.

[0044]In this invention, a judgment of whether to register a certain radio terminal into a transfer-direct table is performed based on a receiving condition of "a packet transmitted to arbitrary addressing to a radio terminal" containing not only a packet addressed to a local station but other radio terminals. Therefore, according to this invention, when a certain radio terminal becomes what fills the above "registration condition", registration to a transfer-direct table can be performed at an early stage as much as possible.

[0045]There is once a case where a radio terminal registered into a transfer-direct table becomes less suitable as an applied object of a transfer-direct method, and, in this case, it is necessary to erase registration of the radio terminal concerned in a transfer-direct table by movement of a radio terminal etc. A judgment of whether to fill the above "registration cancellation conditions" serves as an opportunity of this registration cancellation, a receiving condition when a local station receives a packet which transmitted to the addressing to a radio terminal concerned from

a transmission result or arbitrary radio terminals when this judgment transmits a packet to addressing to a radio terminal by which "local station was registered into said transfer-direct table -- at least -- on the other hand -- " -- it is carried out by being based.
[0046]In this invention, by performing procedure of registration and registration cancellation to the above transfer-direct tables at any time, A radio terminal with a high possibility of succeeding when packet transfer by a transfer-direct method is performed will always be registered into a transfer-direct table, and packet transfer by a transfer-direct method will be performed only for this registered radio terminal.
[0047]Therefore, according to this invention, a possibility that packet transfer by a transfer-direct method will end in failure is low, the packet transfer according to a transfer-direct method as much as possible on the other hand can be performed, a high throughput is obtained and packet transfer can be performed by the shortest possible transfer time.
[0048]Now, as mentioned above, a judgment of whether to fulfill a "registration condition" based on a "receiving condition" can be performed by various kinds of methods, but the following methods are considered to be simplest and exact methods, for example.
[0049]** When it is a receiving level beyond threshold L1 and a packet transmitted to arbitrary addressing to a radio terminal is received once [continuation m] with the same transmitting agency radio terminal, judge a radio terminal to be that by which a radio terminal which is the transmitting origin fulfills said registration condition (claim 2).
** When the same transmitting agency radio terminal receives a packet transmitted to arbitrary addressing to a radio terminal once [in P 1 time / Q] (P1>=Q1) with a receiving level beyond threshold L1, judge with that by which a radio terminal which is the transmitting origin fulfills said registration condition (claim 3).
** Judge with that in which a radio terminal which is the transmitting origin in a receiving level beyond threshold L1 about a packet transmitted to arbitrary addressing to a radio terminal continuation m1 time or when it receives once [in P 1 time / Q] (P1>=Q1) fulfills said registration condition by the same transmitting agency radio terminal (claim 4).
[0050]By making the above-mentioned threshold L1 into a receiving level with which it is satisfied of a necessary packet error rate according to the describing [above] all directions method, When a local station transmits a packet by a transfer-direct method, only a radio terminal which can be transmitted by communication quality by which a necessary packet error rate is fulfilled can be registered into a transfer-direct table, and it can be considered as an applied object of a transfer-direct method.
[0051]Although a method of the above "a judgment of whether to fulfill registration cancellation conditions" can also consider various kinds of methods, the following are considered to be simple and exact methods, for example.
[0052]** When a packet is transmitted by said transfer-direct method and the same transmitting agency radio terminal judges it as packet transmission non completion continuation m2 time, judge with that by which a radio terminal which is the address fulfills said registration cancellation conditions (claim 5).
** When a packet is transmitted by said transfer-direct method and the same transmitting agency radio terminal judges it as packet transmission non completion Q2 time (P2>=Q2) among P 2 times, judge with that by which a radio terminal which is the address fulfills said registration cancellation conditions (claim 6).
** When a packet is transmitted by said transfer-direct method and the same transmitting agency radio terminal judges it as packet transmission non completion Q2 time (P2>=Q2) among

continuation m2 time, or P 2 times, judge with that by which a radio terminal which is the address fulfills said registration cancellation conditions (claim 7).
[0053]** When the same transmitting agency radio terminal receives a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal continuation m 3 times with a receiving level below threshold L2, judge with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions (claim 8).
** The same transmitting agency radio terminal a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal with a receiving level below threshold L2. When it receives Q 3 times in P 3 times (P3>=Q3), it judges with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions (claim 9).
** The same transmitting agency radio terminal a packet which a radio terminal registered into said transfer-direct table transmitted to arbitrary addressing to a radio terminal with a receiving level below threshold L2. Continuation m3 time or when it receives Q 3 times in P 3 times (P3>=Q3), it judges with that by which a radio terminal which is the transmitting origin fulfills said registration cancellation conditions (claim 10).
[0054]** A packet which a radio terminal registered into fixed time and said transfer-direct table transmitted to arbitrary addressing to a radio terminal is not received, And when 1 time does not have transmitting a packet to the registered radio terminal concerned, and becoming packet transmission completion, either, it judges with that by which the registered radio terminal concerned fulfills said registration cancellation conditions (claim 11).
[0055]It is as follows when an effect at the time of adopting the describing [above] all directions method is explained.
[0056]When transfer direct goes wrong, a possibility of failing even if it performs transfer direct to the address radio terminal same immediately after that is very high. According to the above-mentioned ** - **, a possibility that such transfer direct will go wrong can erase registration of a very high radio terminal, and it can except from an object of transfer direct.
[0057]When the above-mentioned ** - ** are adopted, the following characteristic effects are acquired by adjusting the threshold L1 used for a judgment of a registration condition, and the threshold L2 used for a judgment of registration cancellation conditions. First, when and a radio terminal registered into a transfer-direct table moves to a position by which necessary quality is not fulfilled at the time of transfer direct, by erasing registration and changing to a relay transfer method, communication quality can be maintained and a throughput can be raised. [L1=L] If [make L2 into a receiving level with which it is satisfied of a necessary packet error rate, and] L1>L2, change frequency of transfer direct and relay transfer can be controlled, and influence which it has on a radio terminal with a processing load accompanying a change can be inhibited.
[0058]Since registration in a transfer-direct table of a high radio terminal of a possibility that it is separated from a position in which transfer direct is possible in the distance is erased and it changes to relay transfer about the radio terminal concerned when the above-mentioned ** is adopted, useless packet transfer can be prevented and a throughput can be raised.
[0059]Each judgment method about registration cancellation conditions of having explained above may use together two or more kinds of things in order to raise accuracy of a judgment.
[0060]Next, an invention concerning claim 12 said radio terminal, Starting of a receiver, starting of said receiver in a power save mode which repeats a stop periodically, and a cycle of a stop are beforehand notified to said base transceiver station, To said power save mode from an active

mode which maintains said receiver during communication with activation status. Or in performing a change to said active mode from said power save mode conversely, it notifies a mode change to said base transceiver station, When transmitting a packet to other addressing to a radio terminal and the address radio terminal concerned is in said power save mode, Let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-11 transmitting the packet concerned by said relay transfer method irrespective of whether the address radio terminal concerned is registered into said transfer-direct table.

[0061]According to this invention, though it obtained with the address radio terminals concerned and registered with a transfer-direct table while the address radio terminal was operating by a power save mode, a relay transfer method is applied. Therefore, according to this invention, the situation where packet transfer by a transfer-direct method goes wrong by carrying out at an address radio terminal which is operating by a power save mode in addition to an effect of the invention concerning above-mentioned claims 1-12 can be avoided, and an effect that improvement in a throughput can be aimed at is acquired.

[0062]a time of said radio terminal transmitting a packet to other radio terminals, as for an invention concerning claim 13 -- being concerned -- others, in attesting between radio terminals and not succeeding in attestation, being concerned -- others -- irrespective of [whether a radio terminal is registered into said transfer-direct table] -- said relay transfer method -- being concerned -- others -- let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-12 performing packet transfer to a radio terminal.

[0063]If a packet is transmitted by a transfer-direct method when an address radio terminal refuses attestation, a problem of being discarded by the address radio terminal side is solved, a high throughput is obtained by this and packet transfer can be performed by the shortest possible packet transfer time.

[0064]Let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-13 when an invention concerning claim 14 transmits [said radio terminal] a packet by broadcasting, wherein it transmits the packet concerned by said relay transfer method.

[0065]According to this invention, when transmitting a broadcasting packet, a relay transfer method is applied, and when transmitting a unicast packet, a method concerning claims 1-13 will be followed. Therefore, according to this invention, it adds to an effect of the invention concerning above-mentioned claims 1-13, When transfer direct is performed, relay transfer can perform packet transfer also to a radio terminal which cannot receive a broadcasting packet, and an effect that reliability can be improved is acquired in packet transfer.

[0066]An invention concerning claim 15 detects whether said radio terminal is located in within the circle [of a service area of said base transceiver station], or it is located outside the circle, When located in the outside of the circle of a service area of said base transceiver station, let a radio packet transfer method of a statement be a gist at any 1 claim of claims 1-14 transmitting a packet by said transfer-direct method.

[0067]When a radio terminal is located in the outside of the circle of a service area of a base transceiver station according to this invention, Since a packet is transmitted by a transfer-direct method irrespective of whether an address radio terminal is registered into a transfer-direct table, useless packet transfer by a relay transfer method can be prevented, and an effect that improvement in a throughput and shortening of packet transfer time can be aimed at is acquired.

[0068]An invention concerning claim 16 makes a radio packet transfer method of a statement a gist at any 1 claim of claims 1-15, wherein said radio terminal erases registration of all the radio terminals in said transfer-direct table with a change of a base transceiver station which is an in-

zone state place.
[0069]In a case where a transmitting agency radio terminal which is performing packet transfer by a transfer-direct method to a certain address radio terminal changes a base transceiver station in conventional technology, When the concerned transmitting former radio terminal changed and packet transfer was performed by a transfer-direct method to the same address radio terminal as a front, there was a problem that transmission may end in failure, but. According to this invention, after changing a base transceiver station, since a relay transfer method is applied, this problem is solvable first.
[0070]When an invention concerning claim 17 performs wireless packet communication with a base transceiver station and two or more radio terminals and a radio terminal transmits a packet, When packet length of the packet concerned exceeds a fragmentation threshold set up beforehand, In a radio packet transfer method which divides the packet concerned and transmits so that packet length may become below in said fragmentation threshold, said radio terminal, When packet transfer by a relay transfer method that transmit a packet to said base transceiver station, and the base transceiver station concerned transmits the packet concerned to an address radio terminal is performed, Let a radio packet transfer method using a separate fragmentation threshold respectively by a case where packet transfer by a transfer-direct method which transmits the packet concerned to the address radio terminal concerned directly is performed be a gist.
[0071]According to this invention, since a fragmentation threshold which was suitable for each a case of a relay transfer method and in the case of a transfer-direct method can be used, improvement in a throughput can be aimed at.
[0072]When an invention concerning claim 18 performs wireless packet communication with a base transceiver station and two or more radio terminals and a radio terminal transmits a packet, When packet length of the packet concerned exceeds an RTS threshold set up beforehand, Give an identifier and said packet length of a local station to an RTS signal, transmit to an address radio terminal or said base transceiver station, and said address radio terminal or said base transceiver station, In permitting transmission of said packet by a transmitting agency radio terminal of said RTS signal, A radio terminal which gave and transmitted to a CTS signal respectively by having made into a permission address and a reservation period an identifier and packet length which were given to the RTS signal concerned, and transmitted an RTS signal, Said packet is transmitted when a CTS signal which includes an address of a local station as a permission address is received, In a radio packet transfer method which shelves transmission of an RTS signal and a packet until a period equivalent to a reservation period given to the CTS signal concerned expires, when a CTS signal which does not include an address of a local station as a permission address is received, When packet transfer by a relay transfer method that said radio terminal transmits a packet to said base transceiver station, and the base transceiver station concerned transmits the packet concerned to an address radio terminal is performed, Let a radio packet transfer method using a separate RTS threshold respectively by a case where packet transfer by a transfer-direct method which transmits the packet concerned to the address radio terminal concerned directly is performed be a gist.
[0073]According to this invention, since an RTS threshold which was suitable for each a case of a relay transfer method and in the case of a transfer-direct method can be used, improvement in a throughput can be aimed at.
[0074]
[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with

reference to drawings.
[0075]A. Example drawing 1 of composition of the network with which each embodiment of this invention is applied shows the example of composition of the network with which each embodiment of this invention is applied. In this network, each base transceiver stations 10 and 10 and -- accommodate two or more radio terminals. The base transceiver station 10 and the wired terminal 20 are connected by Ethernet 30. Communication with a host (graphic display abbreviation) is performed via one of base transceiver stations with the radio terminals 1, 2, 3, and 4 and --. The base transceiver stations 10 and 10 and -- memorize respectively the MAC Address of the radio terminal which a local station accommodates to the accommodation terminal table 11.
[0076]B. A 1st embodiment book embodiment is an embodiment of a radio packet transfer system which enforces the radio packet transfer method concerning claim 1, The judgment about the above "registration condition" is performed according to the invention concerning claim 2, and the judgment about the above "registration cancellation conditions" is performed according to the invention concerning claim 5.
[0077]Drawing 2 shows the format of the radio packet delivered and received in this embodiment between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station, drawing 2 (a) shows the format of a data packet, and drawing 2 (b) shows the format of the ACK signal (reply signal). The data packet is constituted by a header, data, and frame-check-sequence FCS as shown in drawing 2 (a).
[0078]And the header includes destination address DA, transmission source address SA, a packet kind (a packet kind is "0000" in the case of a data packet), and transmission classification.
[0079]Here, destination address DA is a MAC Address of the radio terminal of an address, or a wired terminal. Transmission source address SA is a MAC Address of the radio terminal of a transmitting agency, or a wired terminal. Transmission classification is information which specifies the transfer method of the packet concerned, It is referred to as "00" when the packet concerned is what is transmitted from a radio terminal that the transfer-direct method should be enforced, It is referred to as "01" at a being [it / what is transmitted from a radio terminal that the relay transfer method should be enforced] case, and it is referred to as "10" when transmitted from a base transceiver station that the relay transfer method should be enforced.
[0080]The ACK signal is constituted by destination address DA, a packet kind (a packet kind is "0001" in the case of an ACK signal), and frame-check-sequence FCS as shown in drawing 2 (b).
[0081]Drawing 3 is a flow chart which shows the example of the receiving operation of the data packet of the radio terminal in this embodiment. In this embodiment, each radio terminal has memorized the transfer-direct table illustrated to drawing 4. Let the MAC Address of the radio terminal judged as the ability of this transfer-direct table to perform packet transfer by the transfer-direct method from the radio terminal concerned be a component. In the receiving operation of the radio terminal in this embodiment, registration of the MAC Address of a radio terminal to this transfer-direct table is performed. In this example of operation, the judgment about the "registration condition" of whether to register a radio terminal to a transfer-direct table has adopted the method set to m1=1 in the invention concerning claim 2. Of course, changing the flow of drawing 3 so that m's1 can be carried out in such a mode well also as two or more is being able to accomplish easily if it is a person skilled in the art. Hereafter, the details are explained with reference to the flow shown in drawing 3.
[0082]A radio terminal's reception of a data packet will judge first whether frame-check-

sequence FCS is normal (Step S101). When this decision result is "NO", reception is ended after discarding the packet concerned (Step S110), and in being "YES", it progresses to Step S102.
[0083]Next, if it progresses to Step S102, it judges whether the transmission classification of the data packet which received is "10", when transmission classification is "10", it progresses to Step S106, and in not being "10", it will progress to Step S103.
[0084]Next, if it progresses to Step S103, it judges whether the receiving level of the data packet concerned is more than threshold L1, and when this decision result is "NO", it will progress to Step S106, and, in "YES", will progress at Step S104.
[0085]Next, if it progresses to Step S104, it judges whether the transmission source address of the data packet concerned is registered into the transfer-direct table, and when this decision result is "YES", it will progress to Step S106, and, in "NO", will progress to Step S105. Next, if it progresses to Step S105, the transmission source address of the data packet concerned will be registered into a transfer-direct table. And it progresses to Step S106.
[0086]Thus, when reception of a data packet is performed. the transmission classification being "00" or "01" (namely, -- the data packet concerned is transmitted by the transfer-direct method or the relay transfer method from other radio terminals), and, And when the receiving level is more than threshold L1, the address of the radio terminal which is the transmitting origin of the data packet concerned is registered into a transfer-direct table. In this case, registration is performed regardless of whether it addresses to a radio terminal besides whether the data packet concerned is a thing addressed to a local station etc.
[0087]Next, if it progresses to Step S106, it will be judged whether the destination address of the data packet concerned is in agreement with the address of a local station. When this decision result is "NO", reception is ended after discarding the packet concerned (Step S110), and in being "YES", it progresses to Step S107.
[0088]Next, if it progresses to Step S107, it will be judged whether the transmission classification of the data packet concerned is "01." When this decision result is "YES", reception is ended after discarding the packet concerned (Step S110). The packet concerned is because it is a normal receiving gestalt which it should be transmitted to a local station by the relay transfer method, and is received via a base transceiver station, although it addressed to the local station and was transmitted to it from other radio terminals.
[0089]on the other hand, when the decision result of Step S107 is "YES", When transfer direct of the data packet concerned is carried out to a local station from other radio terminals (transmission classification "00"), or when relay transfer of the data packet concerned is carried out to a local station via a base transceiver station from other radio terminals (transmission classification "10"), it progresses to Step S108.
[0090]Next, an ACK signal will be transmitted if it progresses to Step S108. When the data packet which received is transmitted from other radio terminals by the transfer-direct method here (transmission classification "00"), When an ACK signal is transmitted to addressing to a radio terminal which is the transmitting origin of the data packet concerned and the data packet concerned is transmitted from a base transceiver station by the relay transfer method (transmission classification "10"), an ACK signal is transmitted to a base transceiver station.
[0091]Next, if it progresses to Step S109, the data packet which received will be passed to the upper layer and reception will be ended.
[0092]In the receiving operation concerning this embodiment described above, it becomes possible to choose relay transfer to the radio terminal which does not fulfill transfer direct and quality to the radio terminal which fulfills the quality at the time of transfer direct by making the

threshold L1 into the receiving level with which it is satisfied of necessary quality.
[0093]Next, with reference to the flow chart shown in drawing 5, the send action of the data packet of the radio terminal in this embodiment is explained. Although this send action includes the processing which erases registration of the radio terminal in a direct communication table, the judgment method which starts claim 5 as the judgment method about the "registration cancellation conditions" whether to erase registration of a certain radio terminal is used for it.
[0094]First, in a radio terminal, if the Request to Send of a data packet arises, a built-in retry counter will be set as "1" (Step S201). Next, it is judged whether the destination address of the data packet concerned is registered into the transfer-direct table (Step S202). When this decision result is "YES", it progresses to Step S203, and in "NO", it progresses to Step S210.
[0095]Next, if it progresses to Step S203 from Step S202, the transfer-direct method will be chosen. Next, it progresses to Step S204, the transmission classification "00" corresponding to the transfer-direct method is set as a data packet, and the data packet concerned is transmitted.
[0096]Next, it progresses to Step S205 and it is judged whether the ACK signal from the radio terminal of an address was received. When this decision result is "YES", with an address radio terminal, the data packet which transmitted considers that it was received normally, and ends a send action.
[0097]On the other hand, when the decision result of Step S205 is "NO", it progresses to Step S206, and it is judged whether the value of a retry counter is smaller than the predetermined threshold m2. And when this decision result is "YES", only "1" makes the value of a retry counter increase (Step S207), only the standby time determined at random stands by (Step S208), and a data packet is transmitted again (Step S204). Hereafter, similarly, an ACK signal is not received from a destination terminal, and when the value of a retry counter is less than [m2], Step S207, S208, and Step S204 are repeated.
[0098]And without receiving an ACK signal, when the value of a retry counter reaches the threshold m2, it progresses to Step S209 from Step S206. If it progresses to this step S209, the destination address of the data packet which is a transmission object will be deleted from a transfer-direct table. It is because it is considered to be difficult to the radio terminal of such a destination address to carry out packet transfer by the transfer-direct method. After processing of this step S209 is completed, it progresses to Step S210. As already explained, also when the destination address of the data packet concerned besides at the time of passing through processing of the above-mentioned step S209 is not registered into a transfer-direct table, it will progress to Step S210.
[0099]Next, if it progresses to Step S210, the relay transfer method will be chosen. Next, it progresses to Step S211, the transmission classification "01" corresponding to the relay transfer method is set as a data packet, and the data packet concerned is transmitted.
[0100]Next, it progresses to Step S212 and it is judged whether the ACK signal from the base transceiver station of an address was received. When this decision result is "YES", it considers that the data packet which transmitted was received normally, and a send action is ended.
[0101]On the other hand, when the decision result of Step S212 is "NO", it progresses to Step S213, and it is judged whether the value of a retry counter is smaller than the predetermined maximum retry count N (however, it is N>m2.). And when this decision result is "YES", only "1" makes the value of a retry counter increase (Step S214), only the standby time determined at random stands by (Step S215), and a data packet is transmitted again (Step S211). Similarly an ACK signal is not hereafter received from the base transceiver station which is an address, and when the value of a retry counter is less than N, Step S214, S215, and Step S211 are repeated.

[0102]And when the value of a retry counter becomes the maximum retry count N, without receiving an ACK signal, it progresses to Step S216 from Step S213, a transmission data packet is discarded, and transmitting processing is ended.
[0103]According to the send action of the data packet in the radio terminal explained above. Even when an address radio terminal foresees during communication of a transmitting agency radio terminal and it moves to the position in which outer transfer direct is impossible, the method of the packet transfer applied to the address radio terminal concerned can be changed into the relay transfer method from the transfer-direct method.
[0104]With reference to the flow chart shown in following drawing 6, the packet relay operation of the base transceiver station in this embodiment is explained. First, if it is the data packet transmitted from the radio terminal and transmission classification receives what is "01" (namely, data packet transmitted from the radio terminal that the relay transfer method should be enforced), a base transceiver station, An ACK signal is transmitted to the radio terminal which is a transmitting agency (Step S301), and the address of the data packet which received judges whether it is a radio terminal accommodated in the base transceiver station concerned (Step S302). A base transceiver station judges whether the address of the data packet concerned is a radio terminal accommodated in the base transceiver station concerned, also when the data packet transmitted from the wired terminal is received (Step S302).
[0105]Processing is ended without performing packet relay operation, when the decision result of this step S302 is "NO."
[0106]On the other hand, when the decision result of Step S302 is "YES", That is, when the address of the data packet which received from the above-mentioned radio terminal or the wired terminal is the radio terminal accommodated in the base transceiver station concerned, relay operation which transmits the data packet concerned to the address radio terminal concerned is performed by the following procedures.
[0107]First, it progresses to Step S303 and the value of a retry counter is set to "1." Next, it progresses to Step S304, the transmission classification "10" which indicates that it is the data packet transmitted from the base transceiver station that the relay transfer method should be enforced is set as the data packet concerned, and it transmits to the addressing to an address radio terminal concerned.
[0108]Next, it progresses to Step S305 and it is judged whether the ACK signal from an address radio terminal was received. When this decision result is "YES", it considers that the data packet which transmitted was received normally, and relay operation is ended.
[0109]On the other hand, when the decision result of Step S305 is "NO", it progresses to Step S306, and it is judged whether the value of a retry counter is smaller than the predetermined maximum retry count N. And when this decision result is "YES", only "1" makes the value of a retry counter increase (Step S307), only the standby time determined at random stands by (Step S308), and a data packet is transmitted again (Step S304). Hereafter, similarly, an ACK signal is not received from an address radio terminal, and when the value of a retry counter is less than N, Step S307, S308, and Step S304 are repeated.
[0110]And when the value of a retry counter becomes the maximum retry count N, without receiving an ACK signal, it progresses to Step S309 from Step S306, the data packet concerned is discarded, and relay processing is ended.
[0111]By operation of the base transceiver station explained above, the packet relay from the relay transfer and the wired terminal of a data packet to other radio terminals [radio terminal] to a radio terminal is attained.

[0112]Next, drawing 7 - drawing 12 show various kinds of examples of operation in this embodiment. Hereafter, with reference to these figures, the example of concrete operation of this embodiment is explained.
[0113]First, the operating-sequence figure of drawing 7 shows the example of operation in case a certain radio terminal B transmits a data packet to addressing to radio terminal A registered into the transfer-direct table. The radio terminal A is registered into the transfer-direct table of the radio terminal B in this example of operation. For this reason, when the data packet which should be transmitted to radio terminal A occurs, the radio terminal B sets transmission classification of the data packet concerned to "00", and makes a destination address the MAC Address of the radio terminal A, and transmits by the transfer-direct method.
[0114]If this data packet is received, the radio terminal A judges whether that receiving level is more than threshold L1, and when it is less than [threshold L1], it will not perform registration to a transfer-direct table. On the other hand, when a receiving level is more than threshold L1, the MAC Address of the radio terminal B which is a transmitting agency is registered into a transfer-direct table. It transmits an ACK signal to addressing to radio terminal B which is the transmitting origin of the data packet concerned while it hands over the data packet concerned to the upper layer, since the data packet which received makes the MAC Address of the radio terminal A a destination address.
[0115]In the radio terminal B side, by reception of this ACK signal, it recognizes that transmission of the above-mentioned data packet was successful, and transmitting processing is ended.
[0116]As explained above, according to this embodiment, about the radio terminal registered into the transfer-direct table. Since a data packet is transmitted to an address radio terminal by the transfer-direct method which does not go via a base transceiver station, while reducing the overheads of relay, the time required of transmission can be shortened.
[0117]Next, in the case where the operating-sequence figure of drawing 8 transmits a data packet to addressing to radio terminal C by which the radio terminal A was registered into the transfer-direct table, The third party slack radio terminal B receives the data packet of this addressing to radio terminal C, and the example of operation in the case of registering the radio terminal A into a transfer-direct table is shown.
[0118]The radio terminal C is registered into the transfer-direct table of the radio terminal A in this example of operation. For this reason, when the data packet which should be transmitted to radio terminal C occurs, the radio terminal A sets transmission classification of the data packet concerned to "00", and makes a destination address the MAC Address of the radio terminal C, and transmits by the transfer-direct method.
[0119]The radio terminal C will transmit an ACK signal to radio terminal A, if this data packet is received. By receiving this ACK signal, the radio terminal A recognizes that transmission of packet data was successful, and ends transmitting processing.
[0120]On the other hand, when the radio terminal B is located in the good place of a prospect for the radio terminal A, the data packet of addressing to radio terminal C transmitted from the radio terminal A may be received by the third party slack radio terminal B. In this case, the radio terminal B judges whether the receiving level of a data packet is more than threshold L1, and when it is more than threshold L1, it registers the MAC Address of the radio terminal A which is the transmitting origin of the data packet which received into a transfer-direct table. Since the data packet which received is a thing addressed to radio terminal C, it is discarded. On the other hand, when a receiving level is less than [threshold L1], registration to a transfer-direct table is

not performed.
[0121]As explained above, when a radio terminal receives the data packet of addressing to a radio terminal of others, and the receiving level is beyond a predetermined threshold, the radio terminal which is a transmitting agency is registered into a transfer-direct table by this embodiment. Therefore, when it is considered as the address of transfer direct, only the high radio terminal of ****** which can perform transfer direct by predetermined communication quality will be registered into a transfer-direct table, and the frequency of failure at the time of performing the transfer-direct method can be lessened.
[0122]Next, the operating-sequence figure of drawing 9 shows the example of operation in case relay transfer is performed from the radio terminal A to the radio terminal B by going via a base transceiver station. The MAC Address of the radio terminal B is not registered into the transfer-direct table of the radio terminal A in this example of operation. For this reason, the radio terminal A chooses the relay transfer method, when the data packet which should transmit to radio terminal B occurs, it makes a destination address the MAC Address of the radio terminal B, sets transmission classification to "01", and transmits the data packet concerned.
[0123]Since the transmission classification is "01" when the above-mentioned data packet is received, a base transceiver station transmits an ACK signal to the radio terminal A.
[0124]By receiving this ACK signal, the radio terminal A recognizes a transmitting success and ends transmitting processing.
[0125]On the other hand, since the address of the above-mentioned data packet is the radio terminal B accommodated in the base transceiver station concerned, a base transceiver station sets transmission classification of the data packet concerned to "10", and transmits the data packet concerned.
[0126]If this data packet is received, that transmission classification is "10", and since that destination address of the radio terminal B corresponds with the address of a local station, it will hand over the data packet concerned to the upper layer, and will transmit an ACK signal to a base transceiver station. By receiving this ACK signal, a base transceiver station recognizes a transmitting success of a data packet, and ends transmitting processing.
[0127]Next, although the radio terminal A transmits a data packet to the radio terminal B registered into the transfer-direct table by the transfer-direct method, the operating-sequence figure of drawing 10 fails in this transmission, and shows the example of operation in the case of changing to the relay transfer method. It is being referred to as m2=1 in this example of operation.
[0128]The MAC Address of the radio terminal B is registered into the transfer-direct table of the radio terminal A in this example of operation. For this reason, the radio terminal A chooses the transfer-direct method, when the data packet which should transmit to radio terminal B occurs, it makes a destination address the MAC Address of the radio terminal B, sets transmission classification to "00", and transmits the data packet concerned.
[0129]However, when the radio terminal B is moving out of this time, for example, the prospect of the radio terminal A, transmission of the above-mentioned data packet will be finished with failure. In this case, although resending of a data packet is performed for the value of a retry counter during the period below threshold m2, if the value of a retry counter reaches the threshold m2, the radio terminal A will erase registration of the radio terminal B in a transfer-direct table.
[0130]Then, the radio terminal A transmits the transmission classification of the data packet addressed to radio terminal B as "01."

[0131]Since the transmission classification is "01" when the above-mentioned data packet is received, a base transceiver station transmits an ACK signal to the radio terminal A.
[0132]By receiving this ACK signal, the radio terminal A recognizes a transmitting success and ends transmitting processing.
[0133]On the other hand, since the address of the above-mentioned data packet is the radio terminal B accommodated in the base transceiver station concerned, a base transceiver station sets transmission classification of the data packet concerned to "10", and transmits the data packet concerned.
[0134]If this data packet is received, that transmission classification is "10", and since that destination address of the radio terminal B corresponds with the address of a local station, it will hand over the data packet concerned to the upper layer, and will transmit an ACK signal to a base transceiver station. By receiving this ACK signal, a base transceiver station recognizes a transmitting success of a data packet, and ends transmitting processing.
[0135]Although each example of operation explained above is a thing in case the address radio terminal and the transmitting agency radio terminal are accommodated in the same base transceiver station, Also in the case where it is respectively accommodated in two base transceiver stations where the radio terminal A which delivers and receives a data packet, and the radio terminal B adjoin so that it may illustrate to drawing 11, Registration of the same transfer-direct table as the above and registration cancellation can be performed, and packet transfer by the transfer-direct method or the relay transfer method can be performed.
[0136]Next, the operating-sequence figure of drawing 12 shows the example of operation in the case of performing packet transfer from the radio terminal A in drawing 11 to the wired terminal Z. First, suppose that the data packet which should transmit to wired terminal Z occurred in the radio terminal A. In this case, since the wired terminal Z is not registered into the transfer-direct table of the radio terminal A, the radio terminal A chooses the relay transfer method, makes a destination address the MAC Address of the wired terminal Z, and transmits transmission classification as "01."
[0137]If this data packet is received, since that transmission classification is "01", a base transceiver station will transmit an ACK signal to the transmitting agency radio terminal A. The radio terminal A recognizes a transmitting success by reception of this ACK signal, and ends transmitting processing.
[0138]On the other hand, since the destination address of the above-mentioned data packet is not a thing of the radio terminal accommodated in the base transceiver station concerned, a base transceiver station changes the data packet concerned into an Ethernet packet, and transmits to Ethernet.
[0139]If the above-mentioned Ethernet packet is received via Ethernet, since the destination address and address of a local station of the wired terminal Z correspond, it will hand over the Ethernet packet concerned to the upper layer.
[0140]As explained above, packet transfer of addressing to a wired terminal by the relay transfer method can be performed without according to this embodiment, producing the useless resending packet by transfer direct, even when an address is a wired terminal.
[0141]In the above, the case where performed a judgment concerning a "registration condition" in the embodiment of the invention concerning claim 1 by the judgment method concerning claim 2, and the judgment about "registration cancellation conditions" was performed by the judgment method concerning claim 5 was explained to the example. However, the judgment method about the "registration condition" and the "registration cancellation conditions" which

were adopted in this embodiment is illustration to the last. In carrying out this invention, the judgment method which starts claim 6 or 7 instead of the judgment method which may adopt the judgment method which starts claim 3 or 4 instead of the judgment method concerning claim 2, and starts claim 5 may be adopted.

[0142]C. It is a radio packet transfer method concerning claim 1, and a 2nd embodiment book embodiment performs the judgment about a "registration condition" by the judgment method concerning claim 2, and it uses together the judgment method which starts the judgment method and claim 8 concerning claim 5 in the judgment about "registration cancellation conditions", and perform it.

[0143]In this embodiment, the format of the radio packet delivered and received between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station is as having been shown in above-shown drawing 2 like a 1st embodiment of the above. Like a 1st embodiment of the above, each radio terminal memorizes the transfer-direct table illustrated to above-shown drawing 4, and performs selection of the transfer-direct method or the relay transfer method according to the contents of registration of this transfer-direct table.

[0144]Drawing 13 is a flow chart which shows the receiving operation of the data packet of the radio terminal in this embodiment. In this receiving operation, the judgment about a "registration condition" is performed by the judgment method set to m1=1 in claim 2, and the judgment about "registration cancellation conditions" is performed by the judgment method set to m3=1 in claim 8. Of course, changing the flow of drawing 13 so that m1 or m3 can be carried out in such a mode well also as two or more is being able to accomplish easily if it is a person skilled in the art.

[0145]A radio terminal will judge first whether frame-check-sequence FCS of the data packet concerned is normal, if a data packet is received (Step S301). And when frame-check-sequence FCS is normal, it progresses to Step S402. When abnormalities are observed in frame-check-sequence FCS, the data packet which received is discarded (Step S413), and reception is ended.

[0146]Next, if it progresses to Step S402, it will be judged whether the transmission classification of the data packet which received is "10." When this decision result is "YES", it progresses to Step S409.

[0147]On the other hand, when the data packet which received is received from a radio terminal that the transfer-direct method should be enforced (transmission classification = "00"), or when the data packet concerned is received from a radio terminal that the relay transfer method should be enforced (transmission classification = "01"). The decision result of Step S402 serves as "NO", and will progress to Step S403.

[0148]Next, if it progresses to Step S403, it will be judged whether the receiving level at the time of reception of the data packet concerned is more than threshold L1. When this decision result is "YES", it progresses to Step S404, and it is judged whether the transmission source address of the data packet concerned is registered into the transfer-direct table of the radio terminal concerned. And when this decision result is "NO", he registers the transmission source address concerned into a transfer-direct table (Step S405), and follows it to Step S409. When the decision result of the above-mentioned step S404 is "YES", it progresses to Step S409, without performing registration (Step S405) to a transfer-direct table.

[0149]On the other hand, when the receiving level of a data packet is less than [threshold L1], it progresses to Step S406 from Step S403, and it is judged whether the receiving level of a data packet is more than threshold L2. Here, when a receiving level is more than threshold L2, it progresses to Step S409. On the other hand, when a receiving level is less than [threshold L2], it

is judged whether the transmission source address of the data packet concerned is registered into the transfer-direct table of the radio terminal concerned (Step S407). And when this decision result is "YES", registration of the transmission source address concerned in a transfer-direct table is erased (Step S408), and it progresses to Step S409. When the decision result of the above-mentioned step S407 is "NO", it progresses to Step S409, without performing registration cancellation (Step S408) in a transfer-direct table.

[0150]Thus, when reception of a data packet is performed in this embodiment. the transmission classification being "00" or "01" (namely, -- the data packet concerned is transmitted by the transfer-direct method or the relay transfer method from other radio terminals), and, And when the receiving level is more than threshold L1, the transmitting agency radio terminal of the data packet concerned is registered into a transfer-direct table. Reception of the data packet whose transmission classification is "00" or "01" is performed, and when the receiving level at that time is less than [threshold L2], registration of the transmitting agency radio terminal of the data packet concerned in a transfer-direct table is canceled. In this case, registration and registration cancellation are performed regardless of whether it addresses to a radio terminal besides whether the data packet concerned is a thing addressed to a local station etc.

[0151]Next, if it progresses to Step S409, it will be judged whether the destination address of the data packet concerned is in agreement with the address of a local station. When this decision result is "NO", reception is ended after discarding the packet concerned (Step S413), and in being "YES", it progresses to Step S410.

[0152]Next, if it progresses to Step S410, it will be judged whether the transmission classification of the data packet concerned is "01." When this decision result is "YES", reception is ended after discarding the packet concerned (Step S413). The packet concerned is because it is a normal receiving gestalt which it should be transmitted to a local station by the relay transfer method, and is received via a base transceiver station, although it addressed to the local station and was transmitted to it from other radio terminals.

[0153]on the other hand, when the decision result of Step S410 is "NO", When transfer direct of the data packet concerned is carried out to a local station from other radio terminals (transmission classification "00"), or when relay transfer of the data packet concerned is carried out to a local station via a base transceiver station from other radio terminals (transmission classification "10"), it progresses to Step S411.

[0154]Next, an ACK signal will be transmitted if it progresses to Step S411. When the data packet which received is transmitted from other radio terminals by the transfer-direct method here (transmission classification "00"), When an ACK signal is transmitted to addressing to a radio terminal which is the transmitting origin of the data packet concerned and the data packet concerned is transmitted from a base transceiver station by the relay transfer method (transmission classification "10"), an ACK signal is transmitted to a base transceiver station.

[0155]Next, if it progresses to Step S412, the data packet which received will be passed to the upper layer and reception will be ended.

[0156]In the receiving operation concerning this embodiment described above, it becomes possible to choose relay transfer to the radio terminal which does not fulfill transfer direct and quality to the radio terminal which fulfills the quality at the time of transfer direct by making the thresholds L1 and L2 into the receiving level with which it is satisfied of necessary quality. The change frequency of transfer direct and relay transfer can be controlled by being referred to as L1>L2. Therefore, when the control load accompanying the change of transfer direct and relay transfer is large, the influence which it has on a radio terminal can be inhibited.

[0157]In the state where the radio terminal A is registered into the transfer-direct table of the radio terminal B, and the radio terminal B is registered into the transfer-direct table of the radio terminal A, drawing 14 shows the example of an operating sequence when packet transfer by the transfer-direct method is performed from the radio terminal A to the radio terminal B.
[0158]As shown in this drawing 14, the radio terminal B will judge whether that receiving level is more than threshold L2, if the packet from the radio terminal A is received. Although the radio terminal A and the radio terminal B were performing communication by the transfer-direct method till then here, when it moves to the place which the radio terminal B left distantly [radio terminal / A], the above-mentioned receiving level in the radio terminal B may be less than [threshold L2]. In such a case, in the radio terminal B, the registration in the transfer-direct table of the radio terminal A which is the transmitting origin of the packet concerned is erased. About the packet which received, it hands over to the upper layer, and an ACK signal is transmitted to radio terminal A.
[0159]By thus, the cause of relative physical relationship with the radio terminal registered into the transfer-direct table getting worse according to this embodiment. When deterioration of the communication quality at the time of performing transfer direct to the addressing to a radio terminal concerned is expected, registration of the radio terminal concerned in a transfer-direct table will be erased, and packet transfer of the addressing to a radio terminal concerned will be performed by the relay transfer method that necessary quality can be maintained.
[0160]As mentioned above, although the characteristic example of this embodiment of operation was explained, about other operations, it is the same as that of operation of a 1st embodiment of the above that already explained. That is, the flow of the send action of the packet of the radio terminal in this embodiment is the same as what was already explained with reference to drawing 5. In operation of the packet transmission shown to drawing 5 that it already explained, the judgment about "registration cancellation conditions" is performed by the judgment method concerning claim 5. Therefore, at this embodiment, the judgment about "registration cancellation conditions" will be performed in accordance with the judgment method which starts claim 8 in the receiving operation (drawing 13) of a radio terminal, and the judgment about "registration cancellation conditions" will be performed in accordance with the judgment method concerning claim 5 by the send action of a radio terminal. The judgment method which starts claim 8 in this way, and the judgment method concerning claim 5 may not be used together, but only the judgment method concerning claim 8 may be used, and the judgment by the judgment method concerning claim 5 may be omitted.
[0161]The operation flow of the packet relay of the base transceiver station in this embodiment is the same as what was already explained with reference to drawing 6. The example of an operating sequence in case a radio terminal transmits a packet to addressing to a radio terminal registered into the transfer-direct table is the same as what was shown in above-shown drawing 7, and the example of an operating sequence in case a radio terminal registers other radio terminals into a transfer-direct table is the same as what was shown in above-shown drawing 8. The example of an operating sequence in case a radio terminal furthermore transmits a packet to addressing to a radio terminal which is not registered into a transfer-direct table is the same as what was shown in above-shown drawing 9. The operating sequence when the packet to which the radio terminal B is registered into the transfer-direct table of the radio terminal A, for example, and the radio terminal B was transmitted from the radio terminal A is unreceivable is the same as what was shown in above-shown drawing 10. Also in the case where it is respectively accommodated in two base transceiver stations where the radio terminal A which

delivers and receives a data packet, and the radio terminal B adjoin so that it may illustrate to above-shown drawing 11, Registration of the same transfer-direct table as the above and registration cancellation can be performed, and packet transfer by the transfer-direct method or the relay transfer method can be performed. The operating sequence in case a radio terminal and a wired terminal perform packet transfer is the same as that of what was shown in above-shown drawing 12.

[0162]As mentioned above, although this embodiment was described to the example, the case where perform the judgment about a "registration condition" by the judgment method concerning claim 2, and it carries out by using together the judgment method which starts the judgment method and claim 8 concerning claim 5 in the judgment about "registration cancellation conditions", The judgment method which starts claim 9 or 10 instead of the judgment method which uses the judgment method which starts claim 6 or 7 instead of the judgment method which uses the judgment method which starts claim 3 or 4 instead of the judgment method concerning claim 2, or starts claim 5, or starts claim 8 may be used. As mentioned above, the judgment by the judgment method concerning claim 5 may be omitted.

[0163]D. In a 3rd embodiment book embodiment, the format of the radio packet delivered and received between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station is as having been shown in above-shown drawing 2 like each above-mentioned embodiment. Like each above-mentioned embodiment, each radio terminal memorizes the transfer-direct table illustrated to above-shown drawing 4, and performs selection of the transfer-direct method or the relay transfer method according to the contents of registration of this transfer-direct table. In this embodiment, a watchdog timer is prepared for each [register with a transfer-direct table] radio terminal of every. About the directions for these watchdog timers, it clarifies in explanation of this embodiment of operation.

[0164]In this embodiment, the radio terminal of the registration condition for registering the MAC Address of arbitrary radio terminals into a transfer-direct table is the same as that of what was already explained in each above-mentioned embodiment.

[0165]He is trying to, require that following either should be filled with this embodiment on the other hand about the registration cancellation conditions for deleting the MAC Address of a radio terminal from a transfer-direct table.

[0166]Registration cancellation condition **: The situation of having transmitted a packet from a local station by the transfer-direct method to the radio terminal concerned, and becoming packet transmission non completion occurred by the frequency beyond a predetermined limit (equivalent to claims 5-7).

[0167]Registration cancellation condition **: The situation where a local station received the packet transmitted with the radio terminal concerned with the receiving level of less than a predetermined threshold occurred by the frequency beyond a predetermined limit (equivalent to claims 8-10).

[0168]Registration cancellation condition ** : The situation where a local station receives the packet which fixed time and the radio terminal concerned transmitted with the receiving level beyond a predetermined threshold does not arise once, And the thing which the situation of transmitting a packet from a local station to the radio terminal concerned, and becoming packet transmission completion does not produce once (equivalent to claim 11).

[0169]A 2nd embodiment of the above is also used for registration cancellation condition ** and ** among the above. In addition to these, the above-mentioned registration cancellation condition ** is used for this embodiment.

[0170]Drawing 15 and drawing 16 are flow charts which show the receiving operation of the data packet of the radio terminal in this embodiment. In most [of receiving operation] most [flows (above-shown drawing 13) and] of a radio terminal in a 2nd embodiment of the above, the flow of this receiving operation is the same. However, Steps S405 and S408 in above-shown drawing 13 are transposed to Step S405A and S408A by this embodiment on the relation which newly added the above-mentioned registration cancellation condition **, and still newer step S421 A-S 423A in this embodiment is added. About other steps, there are not a thing of above-shown drawing 13 and a change. About these, what was used in above-shown drawing 13, and a common thing are used as a number of a step.
[0171]It is as follows when the main point of the receiving operation of the data packet of a radio terminal is explained according to the flow of drawing 15 and drawing 16.
[0172]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet beyond threshold L1, The address of the transmitting agency radio terminal of the data packet concerned is registered into a transfer-direct table, and the watchdog timer corresponding to the concerned transmitting former radio terminal is started (Step S401, S402, S403, S404, S405A). However, when the address of the transmitting agency radio terminal of the data packet concerned is already registered into the transfer-direct table, only processing which restarts a watchdog timer is performed (Step S401, S402, S403, S404, S421A).
[0173]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet below threshold L2, Registration of the address of the transmitting agency radio terminal of the data packet concerned in a transfer-direct table is erased, and the watchdog timer corresponding to the concerned transmitting former radio terminal is stopped (Step S401, S402, S403, S406, S407, S408A).
[0174]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet beyond threshold L2, A watchdog timer is restarted when the address of the transmitting agency radio terminal of the data packet concerned is already registered into the transfer-direct table (Step S401, S402, S403, S406, S422A, S423A).
[0175]The above is the contents of processing of the transfer-direct table relation performed with reception of the data packet by a radio terminal, and watchdog timer-related processing. It is judged whether after finishing these processings, a radio terminal is the transmission classification "00" or the data packet of "10" which the data packet addressed to the local station (Step S409, S410), When this decision result is affirmative, transmission of an ACK signal and delivery to the upper layer of a data packet are performed (Step S412). About the processing after this step S409, there are not a 2nd embodiment of the above and a place which changes in any way.
[0176]Next, drawing 17 is a flow chart which shows the send action of the data packet of the radio terminal in this embodiment. In most [of a send action] most [flows (above-shown drawing 5) and] of a radio terminal in a 1st embodiment of the above, the flow of this send action is the same. However, Step S209 in above-shown drawing 5 is transposed to Step S209A by this embodiment on the relation which newly added the above-mentioned registration cancellation condition **, and the still newer step S221A in this embodiment is added. About other steps, there are not a thing of above-shown drawing 5 and a change. About these, what was used in above-shown drawing 5, and a common thing are used as a number of a step.
[0177]It is as follows when the main point of the send action of the data packet of a radio terminal is explained according to the flow of drawing 17.
[0178]A radio terminal restarts the watchdog timer corresponding to an address radio terminal,

when transmission classification receives an ACK signal after transmission of the data packet which is "00" (transfer direct) (Step S201, S202, S203, S204, S205, S221A).
[0179]After a radio terminal transmits the data packet whose transmission classification is "00" (transfer direct), at however, the time of ** in which a radio terminal does not receive an ACK signal continuously twice [m]. While erasing registration of the address of the address radio terminal concerned in a transfer-direct table, the watchdog timer corresponding to the address radio terminal concerned is stopped (Step S205, S206, S209A).
[0180]In this case, resending of the data packet concerned is performed by the relay transfer method (Steps S210-S216). Since it is the same as what was already explained in a 1st embodiment about this relay transfer method, explanation is omitted here.
[0181]Now, as already explained, the radio terminal in this embodiment performs the time check by a watchdog timer about each radio terminal which registered the address into the transfer-direct table (Step S405A of drawing 15). And if one of watchdog timers becomes time over, the watchdog timer exaggerated routine shown in drawing 18 will perform the radio terminal concerning this embodiment, and the address of the radio terminal corresponding to the watchdog timer used as time over will be deleted from a transfer-direct table.
[0182]When the watchdog timer which started the time check receives a data packet with the receiving level beyond threshold L1 from the radio terminal corresponding to the watchdog timer concerned here (Step S421A of drawing 15), A data packet is received with the receiving level beyond threshold L2 from the radio terminal corresponding to the watchdog timer concerned, And when the radio terminal concerned is registered into the transfer-direct table (Step S423A of drawing 15), or when a data packet is transmitted to the radio terminal corresponding to the watchdog timer concerned by the transfer-direct method and an ACK signal is received (Step S221A of drawing 17), it restarts.
[0183]Therefore, cover fixed time (timer set time of a watchdog timer), and a data packet is not received once with the threshold L1 or the receiving level beyond L2 from the radio terminal corresponding to the watchdog timer concerned, And a data packet is transmitted by the transfer-direct method to the radio terminal corresponding to the watchdog timer concerned, When the situation where it ends with a success does not arise once, (registration cancellation condition ** mentioned above) and the watchdog timer concerned serve as time over, and the registration to the transfer-direct table of the radio terminal corresponding to the watchdog timer concerned is canceled.
[0184]Next, with reference to drawing 19 - each operating-sequence figure of drawing 22, various kinds of examples of this embodiment of operation are explained still more concretely.
[0185]First, drawing 19 shows the operating sequence in case a radio terminal transmits a data packet to addressing to a radio terminal registered into the transfer-direct table by the transfer-direct method.
[0186]The radio terminal A is registered into the transfer-direct table of the radio terminal B in drawing 19. For this reason, in the radio terminal B, if the data packet which should be transmitted to radio terminal A arises, the radio terminal B will choose the transfer-direct method, will make a destination address the MAC Address of the radio terminal A, will set transmission classification to "00", and will transmit the data packet concerned.
[0187]If this data packet is received, it judges a receiving level, and the radio terminal A will register the MAC Address of the transmitting agency radio terminal B into a transfer-direct table, when a receiving level is more than threshold L1, and will start the watchdog timer corresponding to the radio terminal B.

[0188]The transmission classification of the data packet which received is "00", and since the destination address of the radio terminal A corresponds with the MAC Address of a local station, it transmits an ACK signal to transmitting agency radio terminal B, and hands over the data packet concerned to the upper layer.
[0189]If this ACK signal is received, the radio terminal B will recognize that the data packet transmission by the transfer-direct method addressed to radio terminal A was successful, and will restart the watchdog timer corresponding to the radio terminal A.
[0190]Next, drawing 20 shows the operating sequence in the case of registering the transmitting agency radio terminal of the data packet into a transfer-direct table in connection with a radio terminal receiving the data packet transmitted to other addressing to a radio terminal.
[0191]The radio terminal C is registered into the transfer-direct table of the radio terminal A in drawing 20. For this reason, in the radio terminal A, if the data packet which should be transmitted to radio terminal C arises, the radio terminal A will choose the transfer-direct method, will make a destination address the MAC Address of the radio terminal C, will set transmission classification to "00", and will transmit the data packet concerned.
[0192]The radio terminal C will transmit an ACK signal to the transmitting agency radio terminal A, if this data packet is received. It recognizes that the data packet transmission by the transfer-direct method for the radio terminal C finished the radio terminal A with a success by receiving this ACK signal.
[0193]By the way, the data packet of the above-mentioned addressing to radio terminal C may be received by the third party slack radio terminal B.
[0194]In this case, the radio terminal B judges whether a receiving level is more than threshold L1. And when a receiving level is more than threshold L1, the MAC Address of the transmitting agency radio terminal A of the data packet concerned is registered into a transfer-direct table, and the watchdog timer corresponding to the radio terminal A is started. Since it is a thing addressed to radio terminal C, the data packet which received is discarded.
[0195]Next, drawing 21 receives the data packet to which the radio terminal was transmitted by the transfer-direct method, and since the receiving level in that case is less than a threshold, it shows the operating sequence in which a radio terminal erases the registration in the transfer-direct table of the transmitting agency radio terminal of the data packet concerned.
[0196]In drawing 21, the MAC Address of the radio terminal B is registered into the transfer-direct table of the radio terminal A, and the MAC Address of the radio terminal A is registered into the transfer-direct table of the radio terminal B. For this reason, in the radio terminal A, if the data packet which should be transmitted to radio terminal B arises, the radio terminal A will choose the transfer-direct method, will make a destination address the MAC Address of the radio terminal B, will set transmission classification to "00", and will transmit the data packet concerned.
[0197]If this data packet is received, it judges a receiving level, and the radio terminal B will delete the MAC Address of the transmitting agency radio terminal A from a transfer-direct table, when a receiving level is less than [threshold L2], and will stop the watchdog timer corresponding to the radio terminal A.
[0198]The transmission classification of the data packet which received is "00", and since the destination address of the radio terminal B corresponds with the MAC Address of a local station, it transmits an ACK signal to transmitting agency radio terminal A, and hands over the data packet concerned to the upper layer.
[0199]If this ACK signal is received, the radio terminal A will recognize that the data packet

transmission by the transfer-direct method addressed to radio terminal B was successful, and will restart the watchdog timer corresponding to the radio terminal B.
[0200]Next, drawing 22 has illustrated the operating sequence when the watchdog timer corresponding to a certain radio terminal becomes time over in a radio terminal.
[0201]The MAC Address of the radio terminal B is registered into the transfer-direct table of the radio terminal A in drawing 22. Therefore, with the radio terminal A, the time check by the watchdog timer corresponding to the radio terminal B is ******. And although the data packet addressed to radio terminal A is transmitted 3 times by the transfer-direct method from the radio terminal B, all end in the example shown in drawing 22 in failure. For this reason, in the radio terminal A, the watchdog timer corresponding to the radio terminal B serves as time over, and the radio terminal A erases registration of the radio terminal B in a transfer-direct table.
[0202]Then, the data packet which should be transmitted to radio terminal B in the radio terminal A occurs. However, since the radio terminal B is not registered into the transfer-direct table of the radio terminal A at this time, the radio terminal A transmits the data packet addressed to radio terminal B by the relay transfer method.
[0203]In [as explained above] this embodiment, Even if it registers a radio terminal into a transfer-direct table, after that and beyond fixed time. In not receiving the data packet transmitted from the radio terminal concerned and not producing the situation where the transfer direct of the addressing to a radio terminal concerned is successful, either, registration of the radio terminal [in / it is rich and / nothing and a transfer-direct table] concerned which fell into the situation with difficult application of the transfer-direct method by causes, such as movement of the radio terminal concerned, is erased, and the data packet of the addressing to a radio terminal concerned is transmitted by the relay transfer method henceforth.
[0204]As mentioned above, although the characteristic example of this embodiment of operation was explained, about other operations, it is the same as that of operation of 1st and 2nd embodiments of the above that already explained.
[0205]E. A 4th embodiment book embodiment is an embodiment which applied this invention to the radio packet transfer system which consists of a radio terminal which has two kinds of modes, a power save mode and an active mode, and is an embodiment of the invention concerning claim 12.
[0206]Drawing 23 shows the radio packet format delivered and received between the radio terminal and radio terminal in this embodiment, and between a radio terminal and a base transceiver station, drawing 23 (a) is the format of a data packet, and drawing 23 (b) is the format of an ACK signal.
[0207]As shown in drawing 23 (a), the data packet in this embodiment contains the power save mode flag. When setting this power mode flag as "1", transmitting a data packet, when changing to a power save mode, and changing to an active mode, a radio terminal sets this power mode flag as "0", and transmits a data packet.
[0208]A radio terminal notifies beforehand starting of the receiver in a power save mode which can be set working, and the cycle of a stop to a base transceiver station. When the data packet of addressing to a radio terminal which is operating by the power save mode is received, a base transceiver station buffers the data packet concerned, and transmits the data packet concerned to the timing which the receiver of the address radio terminal concerned has started.
[0209]Also in this embodiment, although the data packet by the transfer-direct method can be transmitted from a radio terminal to other radio terminals, When the data packet by the transfer-direct method is transmitted to addressing to a radio terminal which is operating by the power

save mode, a possibility of transmission being performed to the timing which the receiver has stopped and becoming transmitting non completion is high. Then, he is trying to also register into a transfer-direct table the power save mode flag of whether the radio terminal concerned besides the MAC Address of the radio terminal in which each radio terminal can apply the transfer-direct method as shown in drawing 24 is working at a power save mode in this embodiment.

[0210]Drawing 25 and drawing 26 are flow charts which show the receiving operation of the data packet of the radio terminal in this embodiment. In most [of receiving operation] most [flows (above-shown drawing 13) and] of a radio terminal in a 2nd embodiment of the above, the flow of this receiving operation is the same. However, new Step S431B and S432B are added to the flow of above-shown drawing 13 on the relation in which each radio terminal operates not only in an active mode but a power save mode. About other steps, there are not a thing of above-shown drawing 13 and a change. About these, what was used in above-shown drawing 13, and a common thing are used as a number of a step.

[0211]It is as follows when the main point of the receiving operation of the data packet of a radio terminal is explained according to the flow of drawing 25 and drawing 26.

[0212]Transmission classification is "00" or "01", and a radio terminal registers the address of the transmitting agency radio terminal of the data packet concerned into a transfer-direct table, when a receiving level receives the data packet beyond threshold L1 (Step S401, S402, S403, S404, S405).

[0213]When transmission classification of a radio terminal is "00" or "01" and a receiving level receives the data packet below threshold L2, Registration of the address of the transmitting agency radio terminal of the data packet concerned in a transfer-direct table is erased (Step S401, S402, S403, S406, S407, S408).

[0214]A radio terminal judges whether the address of the transmitting agency radio terminal of the data packet concerned is registered into the transfer-direct table, when transmission classification receives the data packet which is "00" or "01" (Step S431B). And when the address of the transmitting agency radio terminal is registered, the power mode save flag corresponding to the concerned transmitting former radio terminal registered into the transfer-direct table is updated with the power save mode flag in the data packet concerned. Since such operation is performed in each radio terminal, when a certain radio terminal transmits a data packet, It will be well-known to the information whether the radio terminal concerned is working at a power save mode, to each radio terminal which received the data packet concerned, and it will be registered into the transfer-direct table of each radio terminal.

[0215]The above is the contents of processing of the transfer-direct table relation performed with reception of the data packet by a radio terminal. It is judged whether after finishing these processings, a radio terminal is the transmission classification "00" or the data packet of "10" which the data packet addressed to the local station (Step S409, S410), When this decision result is affirmative, transmission of an ACK signal and delivery to the upper layer of a data packet are performed (Step S412). About the processing after this step S409, there are not a 2nd embodiment of the above and a place which changes in any way.

[0216]Next, drawing 27 is a flow chart which shows the send action of the data packet of the radio terminal in this embodiment. In most [of a send action] most [flows (above-shown drawing 5) and] of a radio terminal in a 1st embodiment of the above, the flow of this send action is the same. However, the new step S231B is added to the flow of above-shown drawing 5 on the relation in which each radio terminal operates not only in an active mode but a power save

mode. About other steps, there are not a thing of above-shown drawing 5 and a change. About these, what was used in above-shown drawing 5, and a common thing are used as a number of a step.

[0217]It is as follows when the send action of the data packet of the radio terminal in this embodiment is explained according to the flow of drawing 27. That is, a radio terminal judges whether the address corresponding to the address radio terminal of the data packet concerned is registered into the transfer-direct table, when the data packet which should be transmitted to other radio terminals arises (Step S202). And when the address corresponding to an address radio terminal is registered into the transfer-direct table, the contents of the power save mode flag corresponding to the address radio terminal are read from a transfer-direct table, and it is judged whether the power save mode flag concerned is "0." And when the power save mode flag operates by "0" and the address radio terminal is operating by the active mode. Transmission of the data packet concerned by the transfer-direct method is tried (Steps S203-S209), and when this goes wrong, transmission by the relay transfer method is performed (Steps S210-S216). On the other hand, transmission by the relay transfer method is performed, without completely trying transmission by the transfer-direct method, when the power save mode flag operates by "1" and the address radio terminal is operating by the power save mode (Steps S210-S216). Since it is the same as what was already explained in a 1st embodiment about the transmission (Steps S203-S209) by the transfer-direct method, and the transmission (Steps S210-S216) by the relay transfer method, explanation here is omitted.

[0218]Since operation in case a base transceiver station relays a data packet in this embodiment is the same as that of the case (refer to above-shown drawing 6) of a 1st embodiment of the above, explanation is omitted.

[0219]Next, drawing 28 and drawing 29 are the operating-sequence figures showing the example of 1 operation of this embodiment. In this example of operation, when the radio terminal A changes from an active mode to a power save mode, it is transmitting the data packet in advance of it. As for this data packet, in order that the transmitting agency radio terminal A may change to the power save mode, the power save mode flag is "1", and transmission classification has become "01." A base transceiver station transmits an ACK signal to radio terminal A, when this data packet is received, and the radio terminal A recognizes a transmitting success of a data packet by reception of this ACK signal.

[0220]In this example of operation, the radio terminal B has received the above-mentioned data packet transmitted from the radio terminal A. Here, the address of the radio terminal A is registered into the transfer-direct table of the radio terminal B. When the receiving level of the data packet concerned is more than threshold L2, the radio terminal B, The power save mode flag corresponding to the transmitting agency radio terminal A of the data packet concerned in a transfer-direct table is updated with the power save mode flag (= "1") contained in the data packet concerned. Since it is not a thing addressed to radio terminal B, the data packet concerned is discarded.

[0221]Then, in the radio terminal B, the data packet which should be transmitted to radio terminal A occurs. In this example of operation, since the MAC Address of the address radio terminal A is registered into the transfer-direct table of the radio terminal B, the radio terminal B judges whether the power mode save flag corresponding to the address radio terminal A registered into the transfer-direct table is "1." In this case, since the power mode flag concerned is "1", the radio terminal B makes a destination address the MAC Address of the radio terminal A, sets transmission classification to "01", and transmits a data packet. A base transceiver station

will transmit an ACK signal to transmitting agency radio terminal B, if this data packet is received. The radio terminal B recognizes that transmission of the data packet was successful by reception of this ACK signal.

[0222]Here, the base transceiver station grasps the cycle of starting of the receiver of the radio terminal A, and a stop which recognizes that the radio terminal A is operating by the power save mode, and is operating by the power save mode. Then, a base transceiver station buffers the data packet of addressing to radio terminal A which received from the above-mentioned radio terminal B, and transmits the data packet concerned to the timing which the receiver of the radio terminal A is starting. The radio terminal A will be handed over to the upper layer, if this data packet is received.

[0223]F. A 5th embodiment book embodiment is an embodiment of the invention concerning claim 13. The format of the radio packet delivered and received in this embodiment between a radio terminal and a radio terminal and between a radio terminal and a base transceiver station is as having been shown in above-shown drawing 23. The receiving operation of the data packet of a radio terminal is the same as that of a 4th embodiment (drawing 25 and drawing 26) of the above.

[0224]The flow of the send action of a data packet which a radio terminal performs in this embodiment is shown in drawing 30 and drawing 31. New step S241 C-S 247C is added to the flow (drawing 27) of a send action [in / in the flow of this send action / a 4th embodiment of the above]. About other steps, when it changes with the thing in a 4th embodiment of the above, there are nothings. About such a step, the same step number as what was used in drawing 27 is used.

[0225]In the case where a transmitting agency radio terminal tends to transmit a data packet to other addressing to a radio terminal, The address radio terminal concerned is registered into the transfer-direct table, and when the power save mode flag of the address radio terminal concerned is "0" (namely, active mode), A transmitting agency radio terminal chooses the transfer-direct method first (Step S201, S202, S231B, S203).

[0226]Next, a transmitting agency radio terminal judges whether the address radio terminal is registered into the authentication success table (Step S241C). Here, the address of the radio terminal which succeeded in the past and attestation is registered into the authentication success table. The operation which registers the address of a radio terminal to an authentication success table is mentioned later.

[0227]When the decision result of the above-mentioned step S241C is "YES", a transmitting agency radio terminal transmits the data packet by the transfer-direct method to an address radio terminal promptly (Steps S204-S209).

[0228]On the other hand, when the decision result of Step S241C is "NO", a radio terminal judges whether the address radio terminal is registered into the attestation refusal table (Step S242C). Here, the address of the radio terminal in which the past and attestation were refused is registered into the attestation refusal table. The operation which registers the address of a radio terminal to an attestation refusal table is mentioned later.

[0229]When the decision result of the above-mentioned step S242C is "YES", a radio terminal performs processing for transmission of the data packet by the relay transfer method (Steps S210-S216).

[0230]On the other hand, when the decision result of the above-mentioned step S242C is "NO", a radio terminal transmits an authentication demand to an address radio terminal (Step S243C). And it judges whether this attestation was successful (Step S244C), when it succeeds in

attestation, the address of an address radio terminal is registered into an authentication success table (Step S204), and processing for transmission of the data packet by the transfer-direct method is performed (Steps S204-S209). On the other hand, when it does not succeed in attestation, it is judged whether attestation was refused or not (Step S246C). And when attestation is not refused, a radio terminal performs processing for transmission of the data packet by the relay transfer method (Steps S210-S216). When attestation is refused, after registering the address of an address radio terminal into an attestation refusal table (Step S247C), processing for transmission of the data packet by the relay transfer method is performed (Steps S210-S216).

[0231]Since according to this embodiment packet transfer is performed by the relay transfer method when not succeeding in attestation, the situation where the packet which performed transfer direct to the unattested address radio terminal is discarded by the address radio terminal side is avoidable. According to this embodiment, the past and the radio terminal with which attestation was successful are received, Attestation can be omitted, data packet transmission by the transfer-direct method can be performed, and there is an advantage that the data packet by the relay transfer method can be transmitted, without performing procedure for useless attestation to the past and the radio terminal in which attestation was refused.

[0232]Drawing 32 and drawing 33 are the operating-sequence figures showing the example of this embodiment of operation respectively. Hereafter, with reference to these figures, operation of this embodiment is explained still more concretely.

[0233]First, in the example of operation shown in drawing 32, the MAC Address of the address radio terminal B is registered into the transfer-direct table of the radio terminal A, and attestation is not performed between the radio terminal A and the radio terminal B, and attestation is not refused.

[0234]For this reason, if the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A will send an authentication demand to the radio terminal B. When attesting, the radio terminal B sends the notice of an authentication result of a purport which permits attestation to the radio terminal A, and registers the address of the radio terminal A into an attestation permission table.

[0235]The radio terminal A will register the address of the radio terminal B into an attestation permission table, if the above-mentioned notice of an authentication result is received.

[0236]Then, when the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A omits attestation and transmits the data packet by the transfer-direct method to radio terminal B.

[0237]If this data packet is received, the that transmitting former radio terminal A judges whether it is the radio terminal registered into the attestation permission table, and the radio terminal B will transmit an ACK signal to the addressing concerned to radio terminal A, when a decision result is "YES", and will hand over the data packet concerned to the upper layer.

[0238]The radio terminal A recognizes that transmission of the data packet was successful by receiving the ACK signal from the radio terminal B.

[0239]Next, the example of operation shown in drawing 33 is explained. In this example of operation, the MAC Address of the address radio terminal B is registered into the transfer-direct table of the radio terminal A, and attestation is not performed between the radio terminal A and the radio terminal B, and attestation is not refused.

[0240]For this reason, if the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A will send an authentication demand to the radio

terminal B. However, the radio terminal B in this example of operation sends the notice of an authentication result of a purport which refuses attestation to the radio terminal A.
[0241]The radio terminal A will register the address of the radio terminal B into an attestation refusal table, if the above-mentioned notice of an authentication result is received.
[0242]Then, when the data packet which should be transmitted to radio terminal B in the radio terminal A arises, the radio terminal A transmits the data packet by the relay transfer method to radio terminal B, without attesting.
[0243]That is, the radio terminal A makes a destination address the MAC Address of the radio terminal B, sets transmission classification to "01", and transmits a data packet. A base transceiver station will transmit an ACK signal to transmitting agency radio terminal A, if this data packet is received. The radio terminal A recognizes a transmitting success of a data packet by receiving this ACK signal. A base transceiver station sets transmission classification to "10", and transmits the above-mentioned data packet from the radio terminal A. The radio terminal B will be handed over to the upper layer, if this data packet is received.
[0244]The above is a characteristic example of operation in this embodiment. When a radio terminal erases registration of the radio terminal registered into the transfer-direct table in this embodiment, registration cancellation of the radio terminal concerned in an authentication success table or an attestation refusal table is not performed. Therefore, even when the obstacle between radio terminals moves frequently, for example and registration of a transfer-direct table and registration cancellation arise frequently, the register state of an authentication success table or an attestation refusal table does not change with these. For this reason, if the past and attestation were successful when registration to a transfer-direct table was again performed about the radio terminal concerned after registration cancellation in a transfer-direct table was performed about a certain radio terminal, Transfer direct can be performed to the radio terminal concerned, without attesting in piles. The management is needed when it is expected to an authentication success table or an attestation refusal table that a huge number of radio terminals are registered. In this case, when the total of registered radio terminals, such as an authentication success table, is likely to exceed for example, the maximum number of registration, for example, it may be made to erase registration of the oldest thing.
[0245]G. In the 6th embodiment radio packet transfer system, broadcasting which transmits a data packet for an identical content from a radio terminal all at once to other radio terminals of all the may be performed. This embodiment applies this invention to the radio packet transfer system with which such broadcasting is performed, and is an embodiment of the invention concerning claim 14. The format of the radio packet delivered and received between a radio terminal and a base transceiver station in this embodiment is as having been shown in above-shown drawing 23.
[0246]The flow of the receiving operation of a data packet which a radio terminal performs in this embodiment is shown in drawing 34 and drawing 35. The flow of this send action is that to which the new step S451D was added to the flow (drawing 25 and drawing 26) of the send action in a 4th embodiment of the above. About other steps, when it changes with the thing in a 4th embodiment of the above, there are nothings. About such a step, the same step number as what was used in drawing 25 and drawing 26 is used.
[0247]Although it judges whether the destination address of a radio terminal of the data packet which received corresponds with the address of a local station in Step S409 in this embodiment, When this decision result is "NO", it is judged whether the data packet concerned is a broadcasting packet (Step S451D). And when the data packet concerned is a broadcasting

packet, the data packet concerned is handed over to the upper layer (Step S412), and in not being a broadcasting packet, it discards the data packet concerned (Step S413). About other operations, there are not a 4th embodiment of the above and a place which changes in any way.
[0248]Next, the flow of the send action of a data packet which a radio terminal performs in this embodiment is shown in drawing 36 and drawing 37. The flow of this send action is that to which the new step S251D was added to the flow (drawing 30 and drawing 31) of the send action in a 5th embodiment of the above. About other steps, there are not a thing in a 5th embodiment of the above and a changing place. About such a step, the same step number as what was used in drawing 30 and drawing 31 is used.
[0249]When a radio terminal tends to transmit a data packet in this embodiment, it is judged whether the transmission is performed as broadcasting (Step S251D). And when this decision result is "NO", it progresses to Step S201 and the completely same processing as a 5th embodiment of the above is performed henceforth. On the other hand, when the decision result of Step S251D is "YES", broadcasting of the data packet concerned is performed by the relay transfer method (Steps S210-S216).
[0250]Drawing 38 is an operating-sequence figure showing the example of concrete operation of this embodiment. As shown in this drawing 38, when transmitting a data packet by broadcasting, the radio terminal A sets transmission classification to "01", makes a destination address the information corresponding to broadcasting, and transmits the data packet concerned. It sets transmission classification to "10" and transmits the data packet concerned while returning an ACK signal, if a base transceiver station is received [this data packet]. If this data packet is received, all the radio terminals accommodated in the base transceiver station concerned will recognize that the data packet concerned is a broadcasting packet, and will hand it over to the upper layer.
[0251]H. A 7th embodiment book embodiment is an embodiment of the invention which enables it to perform data packet transmission to a desired radio terminal by the transfer-direct method when a radio terminal is in the service outside of the circle of a base transceiver station, and relates to claim 15. Below, this embodiment explains to an example the case where it applies to a 6th embodiment of the above, although it is also possible to apply to any of each already described embodiment.
[0252]In this embodiment, a base transceiver station transmits a reporting signal periodically. It is judged that a radio terminal has a local station in the service outside of the circle of the base transceiver station concerned when it judges that the local station is in the service within the circle of the base transceiver station concerned when this reporting signal is received correctly, and it does not receive correctly.
[0253]The operation flow of the send action of a data packet which a radio terminal performs in this embodiment is shown in drawing 39 and drawing 40. The flow of this send action is that to which the new step S261E was added to the flow (drawing 36 and drawing 37) of the send action in a 6th embodiment of the above. About other steps, there are not a thing in a 6th embodiment of the above and a changing place. About such a step, the same step number as what was used in drawing 36 and drawing 37 is used.
[0254]When a radio terminal tends to transmit a data packet in this embodiment, it is judged whether the local station is in the service within the circle of a base transceiver station (Step S261E).
[0255]And when a local station is in the service outside of the circle (when the decision result of Step S261E is "NO"), a local station is in a service within the circle, And when the address radio

terminal is registered into the transfer-direct table, the data packet transmission to the address radio terminal by the transfer-direct method is tried (Steps S203-S20). (when the decision result of Step S261E and Step S202 is "YES")
[0256]When a local station is in a service within the circle and the address radio terminal is not registered into a transfer-direct table on the other hand (the decision result of Step S261E is "YES", and) And when the decision result of Step S202 is "NO", data packet transmission to the address radio terminal by the relay transfer method is performed (Steps S210-S216). About other points, it is the same as that of a 6th embodiment of the above.
[0257]I. An 8th embodiment book embodiment gives facilities in case a radio terminal changes a base transceiver station (hand-off), and is an embodiment of the invention concerning claim 16. This embodiment can also be applied to any of each already described embodiment.
[0258]Drawing 41 is a flow chart which shows operation in case a radio terminal performs a hand-off in this embodiment. As shown in this figure, a radio terminal will choose the base transceiver station which is a new in-zone state place, if a hand-off is started (Step S501). Here, as an opportunity of a hand-off start, the case where the reporting signal from a base transceiver station is not received, for example as for j continuation can be set up. As a selection method of a new in-zone state place base transceiver station, the total radio-channel frequency in fixed time and a radio packet transfer system can be monitored, and the method of choosing the base transceiver station where the receiving level of the above-mentioned reporting signal is the largest can be taken, for example. Subsequently, a radio terminal erases registration of all the radio terminals in a transfer-direct table (Step S502).
[0259]the case where the radio terminal is carrying out other radio terminals and transfer direct in front of the hand-off according to this embodiment -- after a hand-off -- the relay transfer method -- being concerned -- others -- packet transfer addressed to a radio terminal will be performed.
[0260]J. A 9th embodiment book embodiment applies this invention to the radio packet transfer system which performs packet transfer by the fragmentation division transmission method, and is an embodiment of the invention concerning claim 17. This embodiment can also be applied to any of each already described embodiment.
[0261]The operation flow of the send action of a data packet which a radio terminal performs to drawing 42 in this embodiment is shown. A radio terminal determines whether to transmit the data packet concerned by the transfer-direct method, or transmit by the relay transfer method at the time of transmission of a data packet (Step S601). It is as having already explained the concrete processing for determining this transfer method in each embodiment.
[0262]And when transmitting a data packet by the transfer-direct method, a radio terminal, The data packet concerned is divided so that packet length may become below in the fragmentation threshold concerned, when judging whether it is over the fragmentation threshold in case the packet length of the data packet concerned is transfer direct (Step S602), and having exceeded (Step S603).
[0263]When transmitting a data packet by the relay transfer method, on the other hand, a radio terminal, The data packet concerned is divided so that packet length may become below in the fragmentation threshold concerned, when judging whether it is over the fragmentation threshold in case the packet length of the data packet concerned is relay transfer (Step S604), and having exceeded (Step S605).
[0264]After passing through the above processing, when based on the transfer-direct method, transmission classification of a data packet is set to "00", when based on the relay transfer

method, transmission classification of a data packet is set to "01", and a data packet is transmitted (Step S606).
[0265]It is as having already explained concrete processing of the transfer-direct method and the relay transfer method in each embodiment.
[0266]According to this embodiment, the fragmentation threshold for transfer direct is set as a value suitable for the transmission line between radio terminals, And the fragmentation threshold for relay transfer can be set as a value suitable for the transmission line between a radio terminal and a base transceiver station, and, thereby, a high throughput can be obtained.
[0267]K. A 10th embodiment book embodiment applies this invention to the radio packet transfer system which performs packet transfer with a RTS/CTS random access method, and is an embodiment of the invention concerning claim 18. This embodiment can also be applied to any of each already described embodiment.
[0268]The operating sequence of the data packet transmission by a RTS/CTS random access method is shown in drawing 43. In drawing 43, the transmitting agency radio terminal A gives a transmission source address and packet length to an RTS signal. And in performing transmission by the relay transfer method, transmission classification "01" is given to an RTS signal and it transmits to a base transceiver station, and in performing transmission by the transfer-direct method, transmission classification "00" is given to an RTS signal and it transmits to an address radio terminal. In the example of operation shown in drawing 43, the radio terminal A gave transmission classification "00" to the RTS signal, and has transmitted to radio terminal B so that it may perform transmission by the transfer-direct method.
[0269]The radio terminal B will transmit the CTS signal having contained the packet length which made the permission address the address of the transmitting agency radio terminal A of an RTS signal, and was given to the RTS signal, if transmission classification receives the RTS signal which is "00." Also when a base transceiver station receives the RTS signal whose transmission classification is "01", the same CTS signal is transmitted by the base transceiver station concerned.
[0270]Each radio terminal will judge whether the permission address of the CTS signal concerned is in agreement with the address of a local station, if the above-mentioned CTS signal is received.
[0271]In the example shown in drawing 43, the radio terminal A which is transmitting [the above-mentioned RTS signal] origin will transmit the data packet of addressing to radio terminal B which sets transmission classification to "00", if it checks that the permission address of a CTS signal is in agreement with the address of a local station. The radio terminal B will transmit an ACK signal to radio terminal A, if this data packet is received. The radio terminal A recognizes a transmitting success by receiving this ACK signal.
[0272]On the other hand, since the permission address of other radio terminals C of the above-mentioned CTS signal does not correspond with the address of a local station, transmission of the period equivalent to the packet length contained in a CTS signal, a data packet, and an RTS signal is not performed.
[0273]The above is an outline of operation of the data packet transmission by a RTS/CTS random access method. according to this method -- what is called -- it can hide and the problem of a terminal can be solved.
[0274]Drawing 44 is a flow chart which shows the send action of the data packet of the radio terminal in this embodiment. If the data packet which should be transmitted produces a radio terminal in this embodiment, after setting a retry counter as "1" (Step S701), it will determine

whether to perform data packet transmission by the transfer-direct method, or carry out by the relay transfer method (Step S702).
[0275]When performing data packet transmission by the transfer-direct method is determined, It judges whether the packet length of the data packet concerned is over the RTS threshold for transfer direct (Step S703), when this decision result is "YES", it progresses to Step S705, and in "NO", it progresses to Step S710. When performing data packet transmission by the relay transfer method is determined on the other hand, It judges whether the packet length of the data packet concerned is over the RTS threshold for relay transfer (Step S704), when this decision result is "YES", it progresses to Step S705, and in "NO", it progresses to Step S710.
[0276]Next, packet length is over the RTS threshold for transfer direct, or the RTS threshold for relay transfer, and if it progresses to Step S705 from Step S703 or S704, a radio terminal will transmit an RTS signal. Here, in the case of transfer direct, transmission classification "00" is given to an RTS signal, it transmits, in the case of relay transfer, transmission classification "01" is given to an RTS signal, and it transmits.
[0277]After finishing transmission of this RTS signal, it is judged whether the CTS signal was received (Step S706). And when not receiving a CTS signal, judge whether the value of a retry counter is less than the predetermined value K (Step S707), and in being less than K. While only the time on which it decides at random stands by, only "1" makes a retry counter increase (Step S708), and transmission (Step S705) of an RTS signal is repeated again. Even if it is a case where a CTS signal is received, it is also fundamentally the same as when the permission address included in that CTS signal is not in agreement with the address of a local station, but (Step S709) only time to be equivalent to the packet length contained in a CTS signal in this case postpones transmission of an RTS signal.
[0278]When the destination address which receives a CTS signal after transmission of the above-mentioned RTS signal, and is included in a CTS signal is in agreement with the address of a local station, A data packet is transmitted with the transfer method determined in Step S702 among the transfer-direct method or the relay transfer method (Step S710).
[0279]A data packet is discarded when the value of a retry counter reaches the predetermined value K, without receiving the CTS signal addressed to a local station (Step S711).
[0280]The above is a send action of the data packet of the radio terminal in this embodiment. Since the RTS threshold is set [according to this embodiment] aside the case of transfer direct, and in the case of relay transfer, A high throughput can be obtained by making the RTS threshold for transfer direct into a value suitable for the transmission line between radio terminals, and making the RTS threshold for relay transfer into a value suitable for the transmission line between a radio terminal and a base transceiver station.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure showing the example of composition of the network with which each embodiment of this invention is applied.
[Drawing 2]It is a figure showing the format of the radio packet delivered and received in a 1st embodiment of this invention between a radio terminal and a radio terminal or between a radio terminal and a base transceiver station.
[Drawing 3]It is a flow chart which shows the receiving operation of a data packet performed with a radio terminal in the embodiment.

[Drawing 4]It is the figure which illustrated the contents of the transfer-direct table in the embodiment.
[Drawing 5]It is a flow chart which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 6]It is a flow chart which shows the relay operation of a data packet performed by the base transceiver station in the embodiment.
[Drawing 7]In the embodiment, a radio terminal is an operating-sequence figure showing the example of operation which transmits a data packet to addressing to a radio terminal registered into the transfer-direct table.
[Drawing 8]In the embodiment, a radio terminal is an operating-sequence figure showing the example of operation which registers other radio terminals into a transfer-direct table.
[Drawing 9]In the embodiment, a radio terminal is an operating-sequence figure showing the example of operation which transmits a data packet to addressing to a radio terminal which is not registered into a transfer-direct table.
[Drawing 10]Although a radio terminal transmits a data packet to addressing to a radio terminal registered into the transfer-direct table in the embodiment, it is an operating-sequence figure showing an example of operation when an address radio terminal cannot receive the data packet concerned.
[Drawing 11]It is a figure showing operation in case each radio terminal accommodated in each base transceiver station which adjoins in the embodiment performs data packet transmission.
[Drawing 12]It is an operating-sequence figure showing operation of the data packet transmission performed between a radio terminal and a wired terminal in the embodiment.
[Drawing 13]It is a flow chart which shows the receiving operation of a data packet performed with a radio terminal in a 2nd embodiment of this invention.
[Drawing 14]Although two sets of radio terminals have registered the radio terminal of another side into each transfer-direct table in the embodiment, it is an operating-sequence figure showing an example of operation when the radio terminal of another side receives the data packet which one radio terminal transmitted with the receiving level below threshold L2.
[Drawing 15]It is a flow chart (first half) which shows the receiving operation of a data packet performed with a radio terminal in a 3rd embodiment of this invention.
[Drawing 16]It is a flow chart (second half) which shows the receiving operation of a data packet performed with a radio terminal in the embodiment.
[Drawing 17]It is a flow chart which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 18]It is a flow chart which shows operation when a watchdog timer becomes time over in the embodiment.
[Drawing 19]In the embodiment, a radio terminal is an operating-sequence figure showing the example of operation which transmits a data packet to addressing to a radio terminal registered into the transfer-direct table.
[Drawing 20]In the embodiment, a radio terminal is an operating-sequence figure showing the example of operation which registers other radio terminals into a transfer-direct table.
[Drawing 21]Although a radio terminal transmits a data packet to addressing to a radio terminal registered into the transfer-direct table in the embodiment, it is an operating-sequence figure showing an example of operation when an address radio terminal receives the data packet concerned with the receiving level below threshold L2.
[Drawing 22]The radio terminal is registered into the transfer-direct table in the embodiment,

and it is an operating-sequence figure showing an example of operation when a watchdog timer becomes time over.
[Drawing 23]It is a figure showing the format of the radio packet delivered and received in a 4th embodiment of this invention between a radio terminal and a radio terminal or between a radio terminal and a base transceiver station.
[Drawing 24]It is the figure which illustrated the contents of the transfer-direct table in the embodiment.
[Drawing 25]It is a flow chart (first half) which shows the receiving operation of a data packet performed with a radio terminal in the embodiment.
[Drawing 26]It is a flow chart (second half) which shows the receiving operation of a data packet performed with a radio terminal in the embodiment.
[Drawing 27]It is a flow chart which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 28]It is an operating-sequence figure (first half) showing an example of operation when a radio terminal changes from an active mode to a power save mode in the embodiment.
[Drawing 29]It is an operating-sequence figure (second half) showing an example of operation when a radio terminal changes from an active mode to a power save mode in the embodiment.
[Drawing 30]It is a flow chart (first half) which shows the send action of a data packet performed with a radio terminal in a 5th embodiment of this invention.
[Drawing 31]It is a flow chart (second half) which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 32]When the radio terminal B is registered into the transfer-direct table of the radio terminal A in the embodiment and the radio terminal B has not been attested, it is an operating-sequence figure showing an example of operation in case the radio terminal B permits attestation.
[Drawing 33]When the radio terminal B is registered into the transfer-direct table of the radio terminal A in the embodiment and the radio terminal B has not been attested, it is an operating-sequence figure showing an example of operation in case the radio terminal B refuses attestation.
[Drawing 34]It is a flow chart (first half) which shows the receiving operation of a data packet performed with a radio terminal in a 6th embodiment of this invention.
[Drawing 35]It is a flow chart (second half) which shows the receiving operation of a data packet performed with a radio terminal in the embodiment.
[Drawing 36]It is a flow chart (first half) which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 37]It is a flow chart (second half) which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 38]It is an operating-sequence figure showing an example of operation in case broadcasting is performed in the embodiment.
[Drawing 39]It is a flow chart (first half) which shows the send action of a data packet performed with a radio terminal in a 7th embodiment of this invention.
[Drawing 40]It is a flow chart (second half) which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 41]It is a flow chart which shows the operation at the time of the hand-off performed with a radio terminal in an 8th embodiment of this invention.
[Drawing 42]It is a flow chart which shows the send action of a data packet performed with a radio terminal in a 9th embodiment of this invention.

[Drawing 43]It is an operating-sequence figure showing the example of the data packet transmission by the RTS/CTS random access method to which a 10th embodiment of this invention is applied of operation.
[Drawing 44]It is a flow chart which shows the send action of a data packet performed with a radio terminal in the embodiment.
[Drawing 45]It is a figure explaining the transfer-direct method and the relay transfer method.
[Description of Notations]
10 Base transceiver station
11 Accommodation terminal table
1-4A, B, and C Radio terminal
20 Z Wired terminal
30 Ethernet

[Translation done.]

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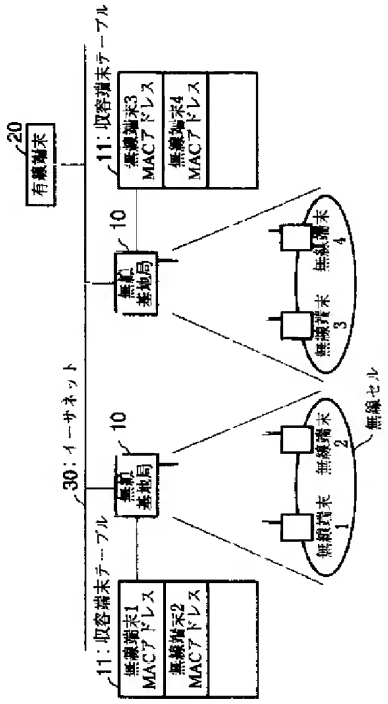
最終頁に続く

(54)【発明の名称】　無線パケット転送方法

(57)【要約】

【課題】　直接転送方法によるパケット転送が失敗に終わる可能性が低く、その一方、可能な限り直接転送方法によるパケット転送を行うことができる無線パケット転送方法を提供する。

【解決手段】　無線端末１～４は、任意の無線端末宛てに送信されたパケットの自局における受信状況等に基づき、直接転送方法によるパケット転送が成功する可能性が高い無線端末のみを直接転送テーブルに登録し、この登録した無線端末のみは直接転送方法の適用対象とし、他の無線端末に対しては無線基地局１０経由の中継転送方法を適用する。



【特許請求の範囲】
【請求項１】　無線端末が他の無線端末に宛ててパケットを送信する場合に、当該送信元無線端末が無線基地局に対してパケットを送信し、当該無線基地局が当該宛先無線端末に当該パケットを送信する中継転送方法、または、当該送信元無線端末が当該宛先無線端末に当該パケットを直接送信する直接転送方法のいずれかを選択し、選択した方法により当該パケットの転送を行い、前記宛先無線端末および前記無線基地局は前記パケットを誤りなく受信した場合に応答信号を送信し、前記送信元無線端末は、前記パケットの送信後一定期間内に前記応答信号を受信した場合にはパケット送信完了と判断し、前記パケットの送信後一定期間内に前記応答信号を受信しない場合にはパケット送信不完了と判断して当該パケットの再送を行う無線パケット転送方法において、
前記無線端末は、
ａ．前記直接転送方法の適用が可能な無線端末を特定する直接転送テーブルを記憶し、
ｂ．任意の他の無線端末宛てにパケットを転送するとき、当該宛先無線端末が前記直接転送テーブルに登録されていない場合には前記中継転送方法によりパケットの転送を行い、当該宛先無線端末が前記直接転送テーブルに登録されている場合には前記直接転送方法によりパケットの転送を行い、
ｃ．任意の無線端末宛てに送信されたパケットの自局における受信状況に基づき、当該パケットの送信元無線端末が前記直接転送テーブルに登録されるための登録条件を満たすか否かの判定を行い、当該登録条件を満たす場合に当該送信元無線端末を前記直接転送テーブルに登録し、
ｄ．自局が前記直接転送テーブルに登録された無線端末宛てにパケットを送信した場合の送信結果または任意の無線端末から当該無線端末宛てに送信したパケットを自局が受信した場合の受信状況の少なくとも一方に基づき、前記直接転送テーブルにおける当該無線端末の登録を抹消するための登録抹消条件を満たすか否かの判定を行い、当該登録抹消条件を満たす場合に前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする無線パケット転送方法。
【請求項２】　前記無線端末は、任意の無線端末宛てに送信されたパケットを、同一の送信元無線端末で閾値Ｌ１以上の受信レベルで、連続ｍ１回受信した場合に、その送信元である無線端末が前記登録条件を満たすものと判定し、当該無線端末を前記直接転送テーブルに登録することを特徴とする請求項１に記載の無線パケット転送方法。
【請求項３】　前記無線端末は、任意の無線端末宛てに送信されたパケットを、当該送信元無線端末で閾値Ｌ１以上の受信レベルで、Ｐ１回中Ｑ１回（Ｐ１≧Ｑ１）受信したとき、その送信元である無線端末が前記登録条件を満たすものと判定し、当該無線端末を前記直接転送テーブルに登録することを特徴とする請求項１に記載の無線パケット転送方法。
【請求項４】　前記無線端末は、任意の無線端末宛てに送信されたパケットを、同一の送信元無線端末で閾値Ｌ１以上の受信レベルで、連続ｍ１回またはＰ１回中Ｑ１回（Ｐ１≧Ｑ１）受信したとき、その送信元である無線端末が前記登録条件を満たすものと判定し、当該無線端末を前記直接転送テーブルに登録することを特徴とする請求項１に記載の無線パケット転送方法。
【請求項５】　前記無線端末は、前記直接転送方法によりパケットの転送を行い、同一の送信元無線端末で連続ｍ２回、パケット送信不完了と判断した場合に、その宛先である無線端末が前記登録抹消条件を満たすものと判定し、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～４のいずれか１の請求項に記載の無線パケット転送方法。
【請求項６】　前記無線端末は、前記直接転送方法によりパケットの転送を行い、同一の送信元無線端末でＰ２回中Ｑ２回（Ｐ２≧Ｑ２）、パケット送信不完了と判断した場合に、その宛先である無線端末が前記登録抹消条件を満たすものと判定し、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～４のいずれか１の請求項に記載の無線パケット転送方法。
【請求項７】　前記無線端末は、前記直接転送方法によりパケットの転送を行い、同一の送信元無線端末で連続ｍ２回あるいはＰ２回中Ｑ２回（Ｐ２≧Ｑ２）、パケット送信不完了と判断した場合に、その宛先である無線端末が前記登録抹消条件を満たすものと判定し、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～４のいずれか１の請求項に記載の無線パケット転送方法。
【請求項８】　前記無線端末は、前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを、同一の送信元無線端末で閾値Ｌ２未満の受信レベルで、連続ｍ３回受信したとき、その送信元である無線端末が前記登録抹消条件を満たすものと判定し、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～７のいずれか１の請求項に記載の無線パケット転送方法。
【請求項９】　前記無線端末は、前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを、同一の送信元無線端末で閾値Ｌ２未満の受信レベルで、Ｐ３回中Ｑ３回（Ｐ３≧Ｑ３）受信したとき、その送信元である無線端末が前記登録抹消条件を満たすものと判定し、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～７のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１０】　前記無線端末は、前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを、同一の送信元無線端末で閾値Ｌ２未満の受信レベルで、連続ｍ３回あるいはＰ３回中Ｑ３回（Ｐ３≧Ｑ３）受信したとき、その送信元である無線端末が前記登録抹消条件を満たすものと判定し、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～７のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１１】　前記無線端末は、一定期間、前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを受信せず、かつ、当該登録された無線端末に対してパケットの転送を行ってパケット送信完了となることが１回もないとき、当該登録された無線端末が前記登録抹消条件を満たすものとし、前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする請求項１～１０のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１２】　前記無線端末は、受信機の起動と停止を周期的に繰り返すパワーセーブモードにおける前記受信機の起動と停止の周期を予め前記無線基地局に通知し、通信中に、前記受信機を起動状態のまま維持するアクティブモードから前記パワーセーブモードへ、あるいは逆に前記パワーセーブモードから前記アクティブモードへの切り換えを行う場合には前記無線基地局にモード切り換えの通知を行い、他の無線端末宛てにパケットの転送を行う場合において当該宛先無線端末が前記パワーセーブモードにある場合には、前記直接転送テーブルに当該宛先無線端末が登録されているか否かに拘わらず、前記中継転送方法により当該パケットの転送を行うことを特徴とする請求項１～１１のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１３】　前記無線端末は、他の無線端末にパケットを転送するときに、当該他の無線端末との間で認証を行い、認証に成功しない場合には、当該他の無線端末が前記直接転送テーブルに登録されているか否かに拘わらず、前記中継転送方法により、当該他の無線端末へのパケット転送を行うことを特徴とする請求項１～１２のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１４】　前記無線端末は、ブロードキャストによるパケットの転送を行う場合には、前記中継転送方法により当該パケットの転送を行うことを特徴とする請求項１～１３のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１５】　前記無線端末は、前記無線基地局のサービスエリアの圏内に位置するか圏外に位置するかを検出し、前記無線基地局のサービスエリアの圏外に位置する場合には前記直接転送方法によりパケットの転送を行うことを特徴とする請求項１～１４のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１６】　前記無線端末は、在圏先である無線基地局の切り替えに伴って、前記直接転送テーブルにおける全ての無線端末の登録を抹消することを特徴とする請求項１～１５のいずれか１の請求項に記載の無線パケット転送方法。

【請求項１７】　無線基地局と複数の無線端末で無線パケット通信を行い、無線端末がパケットを送信するとき、当該パケットのパケット長が予め設定されたフラグメント閾値を越える場合には、パケット長が前記フラグメント閾値以下となるように当該パケットを分割して送信する無線パケット転送方法において、
前記無線端末は、前記無線基地局に対してパケットを送信し、当該無線基地局が宛先無線端末に当該パケットを送信する中継転送方法によるパケット転送を行う場合と、当該宛先無線端末に当該パケットを直接送信する直接転送方法によるパケット転送を行う場合とで各々別個のフラグメント閾値を使用することを特徴とする無線パケット転送方法。

【請求項１８】　無線基地局と複数の無線端末で無線パケット通信を行い、無線端末がパケットを送信するとき、当該パケットのパケット長が予め設定されたＲＴＳ閾値を越える場合には、ＲＴＳ信号に自局の識別子と前記パケット長を付与して宛先無線端末または前記無線基地局に送信し、前記宛先無線端末または前記無線基地局は、前記ＲＴＳ信号の送信元無線端末による前記パケットの転送を許可する場合には、当該ＲＴＳ信号に付与された識別子およびパケット長を各々許可アドレスおよび予約期間としてＣＴＳ信号に付与して送信し、ＲＴＳ信号の送信を行った無線端末は、自局のアドレスを許可アドレスとして含むＣＴＳ信号を受信した場合に前記パケットを送信し、自局のアドレスを許可アドレスとして含まないＣＴＳ信号を受信した場合には当該ＣＴＳ信号に付与された予約期間に相当する期間が終了するまでＲＴＳ信号およびパケットの送信を見送る無線パケット転送方法において、
前記無線端末は、前記無線基地局に対してパケットを送信し、当該無線基地局が宛先無線端末に当該パケットを送信する中継転送方法によるパケット転送を行う場合と、当該宛先無線端末に当該パケットを直接送信する直接転送方法によるパケット転送を行う場合とで各々別個のＲＴＳ閾値を使用することを特徴とする無線パケット転送方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、無線パケット通信における無線パケット転送方法に関する。

【０００２】

【従来の技術】従来、この種の無線パケット転送方法として以下のものがあった。

【０００３】（１）Ｒａｎｇｅ　ＬＡＮ２　自動切り替え

方法
Ｒａｎｇｅ ＬＡＮ２は、２．４ＧＨｚ帯の無線ＬＡＮ製品である。このＲａｎｇｅ ＬＡＮ２では、送信元無線端末が無線基地局を介して宛先無線端末にパケットを転送する中継転送方法または送信元無線端末が直接宛先無線端末にパケットを転送する直接転送方法を選択的に使用してパケット転送が行われる。また、この場合に中継転送方法と直接転送方法のいずれによりパケット転送を行うかは、送信元無線端末側で自動的に切り替えられる。さらに詳述すると、次の通りである。
【０００４】送信元の無線端末は、他の無線端末宛てに転送すべきパケットが生じた場合、まず、直接転送方法により、当該宛先無線端末へ当該パケットを直接転送する。その後、送信元無線端末は、一定期間内に宛先無線端末からの応答信号を受信しない場合にはパケットを再送する。そして、送信元無線端末は、パケットを３回送信しても応答信号を受信しない場合には、当該宛先無線端末に対するパケット転送の方法を中継転送方法に切り替えるのである。以後、送信元無線端末は、当該宛先無線端末に対しては中継転送方法によりパケットの転送を行い、一定期間継続して当該宛先無線端末との間でパケット転送が行われない場合に、当該宛先無線端末に対するパケット転送の方法を再び直接転送方法に切り替える。
【０００５】（２）フラグメント分割送信方法
ＩＥＥＥ８０２．１１委員会では、無線ＬＡＮの標準規格の策定が進められている。そして、同委員会において策定された標準規格案では、フラグメント分割送信方法をサポートしている。このフラグメント分割送信方法では、無線端末がパケットを送信する場合において当該パケットが予め定められた閾値（フラグメント閾値）を越える場合、パケット長がこのフラグメント閾値以下となるように当該パケットを分割して送信する。なお、この技術に関連する参考文献として、“ＩＥＥＥ P202.11,Draft Standard For Wireless LAN Medium Access Control(MAC) and Physical Layer (PHY) Specification, D6.1”がある。
【０００６】（３）ＲＴＳ／ＣＴＳランダムアクセス方法
上記ＩＥＥＥ８０２．１１委員会において策定された無線ＬＡＮの標準規格案では、上記フラグメント分割送信方法の他、ＲＴＳ／ＣＴＳランダムアクセス方法をサポートしている。
【０００７】このＲＴＳ／ＣＴＳランダムアクセス方法では、無線端末がパケットを送信する場合において当該パケットのパケット長が予め定められた閾値（ＲＴＳ閾値）を越える場合、無線チャネルの予約を要求するためのＲＴＳ（Request To Send）信号に送信元無線端末の識別子（送信元アドレス）とパケット長を付与して宛先無線端末または無線基地局に送信する。
【０００８】宛先無線端末または無線基地局は、このＲＴＳ信号を受信すると、無線チャネルの予約要求を許可し、これを他の無線端末または無線基地局に報知するために、ＲＴＳ信号の送信元アドレスを許可アドレスとし、パケット長を予約期間として、ＣＴＳ（Clear To Send）信号に付与して送信する。
【０００９】ＲＴＳ信号を送信した送信元無線端末は、このＣＴＳ信号を受信すると、ＣＴＳ信号によって示される許可アドレスと当該送信元無線端末のアドレスとが一致しているか否かを判定する。そして、両アドレスが一致している場合にはパケットを送信し、一致していない場合には予約期間が終了するまではパケットおよびＲＴＳ信号の送信を行わない。
【００１０】この方法によれば、受信側がＣＴＳ信号により無線チャネルの予約を報知した後、送信側がパケットを送信するため、いわゆる隠れ端末の問題を解決することができる。なお、この方法に関する参考文献として、既に挙げた“ＩＥＥＥ P202.11,Draft Standard For Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, D6.1”がある。
【００１１】
【発明が解決しようとする課題】ところで、上述した各従来技術には以下の問題があった。
【００１２】（１）Ｒａｎｇｅ ＬＡＮ２ 自動切り替え方法の問題
【００１３】① 直接転送を行うことができない２台の無線端末でパケット転送を行う場合にパケット転送が終了するまでの所要時間の増加および無線パケットシステム全体のスループットの劣化が生じる。
【００１４】例えば図４５はこのような問題が生じる状況の一例を示すものである。この図４５に示す例では、無線端末ａと無線端末ｂとの間に遮蔽物Ｓが介在しており、両者は直接転送することができない。このような場合において、例えば無線端末ａがＲａｎｇｅ ＬＡＮ２ 自動切り替え方法に従って無線端末ｂ宛てにパケットを送信するものとすると、無線端末ａは直接転送方法によるパケット転送を３回試みた後、無線基地局１０を経由した中継転送方法に切り替えを行うこととなるため、パケット転送が最終的に成功するまでの所要時間が長くなってしまうのである。また、直接転送方法により３回のパケット転送が行われるため、無線チャネル資源が無駄に消費され、無線パケットシステム全体のスループットが劣化するという問題が生じるのである。また、以上の各問題は、無線基地局が有線パケット網に接続されたネットワーク構成においても生じる。この場合、無線基地局のサービスエリアに在圏する無線端末は、有線端末と直接転送を行うことはできない。しかし、Ｒａｎｇｅ ＬＡＮ２ 自動切り替え方法に従うものとすると、このような場合でも無線端末は有線端末宛てに３回直接転送を試みた後、中継転送方法への切り替えを行うこととな

るため、パケット転送の所要時間の増加および無線パケットシステム全体のスループットの劣化の問題が生じるのである。

【００１５】㉒一旦、直接転送方法から中継転送方法への切り替えが行われると、その後、送信元無線端末にとって直接転送可能な位置に宛先無線端末が移動したとしても、送信元無線端末と宛先無線端末との間の通信が一定期間以上連続して途絶えない限り、直接転送方法への切り替えが行われない。従って、本来直接転送可能である無線端末同士が無駄に無線基地局を使用して通信を行うこととなり、無線基地局を経由することによるパケット転送時間の増加および無線チャネル資源の消費による転送効率の低下を招くという問題がある。

【００１６】㉓パワーセーブモードに関連した問題

無線端末が、受信機の起動と停止を周期的に繰り返すパワーセーブモードで動作しているときに、当該無線端末宛てにパケットが転送される場合がある。かかる場合において、無線端末の受信機が停止状態にある期間に当該無線端末にパケットが転送されてくると、パケットの受信が行われず、結果として無線チャネルが無駄に消費され、無線パケットシステム全体のスループットの劣化が生じるという問題がある。

【００１７】㉔無線端末の認証に関連した問題

Ｒａｎｇｅ ＬＡＮ２ 自動切り替え方法に従うものとすると、無線端末が、認証を拒否した他の無線端末に直接転送方法によりパケットを転送するということが起こり得る。この場合、パケットは、認証を拒否した無線端末側で廃棄されることとなるため、結果として無線チャネルが無駄に消費され、無線パケットシステム全体のスループットの劣化が生じるという問題がある。

【００１８】㉕ブロードキャストを行う場合の問題

複数の無線端末に対して同一のパケットを一斉に転送するブロードキャストが行われる場合がある。このブロードキャストが行われる無線パケットシステムに上記Ｒａｎｇｅ ＬＡＮ２ 自動切り替え方法を適用するものとすると、ブロードキャストの対象であるパケット（ブロードキャストパケット）が、まず、直接転送方法により各無線端末に転送されることとなるため、送信元無線端末から見て直接転送することが不可能な位置に所在する無線端末は、ブロードキャストパケットを受信することができないという問題がある。

【００１９】㉖無線基地局の切り替えが生じる場合の問題

無線端末が移動し、在圏先である無線基地局が切り替わる場合がある。この場合、移動前において、ある宛先無線端末に対し直接転送方法によりパケット転送を行っていた無線端末は、移動後、同じ宛先無線端末に対しては直接転送方法によりパケット転送を行うこととなる。しかし、無線基地局の切り替えにより、宛先無線端末との間で直接転送方法によるパケット転送が困難になることがあり、その場合には直接転送が失敗に終わり、無線チャネル資源が無駄に消費され、無線パケット転送システム全体のスループットが劣化するという問題がある。また、無線基地局の切り替えに伴って通信に使用するチャネル周波数が変化したとき、切り替え前に直接転送方法によりパケットを転送していた宛先無線端末に対し、切り替え後に新たなチャネル周波数で直接転送方法によりパケットを転送した場合に失敗に終わることがある。この場合も、無線チャネル資源が無駄に消費され、無線パケット転送システム全体のスループットが劣化するという問題がある。

【００２０】（２）フラグメント分割送信方法の問題

一般に無線パケット転送においては、パケット長が長くなるにつれて無線伝送路においてパケット誤りが生じる確率が高くなる。フラグメント分割方法によれば、フラグメント閾値を越えるパケットについては、パケット長がフラグメント閾値以下になるように分割してから送信を行うので、この問題を解決することができる。

【００２１】しかし、パケットを分割して送信する場合、分割後の各パケットにはヘッダが付与されるため、スループットが劣化する要因となる。

【００２２】従って、フラグメント分割送信方法を適用する場合には、その対象となる無線パケット転送システムの無線伝送路における誤り率を考慮し、誤り率が大きい場合にはフラグメント閾値を小さくし、誤り率が小さい場合にはフラグメント閾値を大きくすることが望まれる。

【００２３】ところで、無線パケット転送システムにおいて、無線基地局は一般に天井等の無線端末を見通せる位置に設置される。一方、無線端末は、机上等、専ら低い位置で使用される。従って、無線端末と無線端末との間の伝送路は、無線端末と無線基地局との間の伝送路に比べて誤り率が大きい。

【００２４】従って、無線端末が中継転送方法と直接転送方法を切り替えて使用する無線パケット転送システムにおいて、フラグメント閾値を無線端末と無線基地局との間の伝送路に適した値にすると、直接転送方法によるパケット転送時にパケット誤り率が大きくなりスループットが低下するという問題がある。逆にフラグメント閾値を無線端末と無線端末との間の伝送路に適した値にすると、中継転送方法によるパケット転送時にパケット分割によるオーバヘッドによりスループットが低下するという問題がある。

【００２５】（３）ＲＴＳ／ＣＴＳランダムアクセス方法の問題

ＲＴＳ／ＣＴＳランダムアクセス方法によれば、受信局がＣＴＳ信号を送信して無線伝送路の予約を宣言するので、いわゆる隠れ端末問題を解決してスループットを向上することができる。しかし、この方法の場合、ＲＴＳ信号とＣＴＳ信号の授受が必要であり、これによるオー

バヘッドがスループット劣化の要因となる。
【００２６】従って、ＲＴＳ／ＣＴＳランダムアクセス方法を適用する場合には、その対象となる無線パケット転送システムにおいて隠れ端末の発生する確率を考慮し、隠れ端末の発生する確率が大きい場合にはＲＴＳ閾値を小さくして隠れ端末による影響を防止し、隠れ端末の発生する確率が小さい場合にはＲＴＳ閾値を大きくしてＲＴＳ信号およびＣＴＳ信号の授受に係るオーバヘッドを抑制し、スループットを高めることが望まれる。
【００２７】ところで、上述したように、無線基地局は一般に天井等の無線端末を見通せる位置に設置され、無線端末は、机上等、専ら低い位置で使用される。従って、無線端末と無線端末との間の伝送路は、無線端末と無線基地局との間の伝送路に比べて電波遮蔽物の影響を受けやすく、隠れ端末が生じる確率が高い。
【００２８】従って、無線端末が中継転送方法と直接転送方法を切り替えて使用する無線パケット転送システムにおいて、ＲＴＳ閾値を無線端末と無線基地局との間の伝送路に適した値にすると、直接転送方法によるパケット転送時に隠れ端末が生じやすくなりスループットが低下するという問題がある。逆にＲＴＳ閾値を無線端末と無線端末との間の伝送路に適した値にすると、中継転送方法によるパケット転送時にＲＴＳ信号およびＣＴＳ信号の授受に係るオーバヘッドによりスループットが低下するという問題がある。
【００２９】以上が上述した各従来技術が有している諸問題である。
【００３０】この発明は、以上の事情に鑑みてなされたものであり、その第１の目的は、直接転送方法によるパケット転送が失敗に終わる可能性が低く、その一方、可能な限り直接転送方法によるパケット転送を行うことができる無線パケット転送方法を提供することにある。
【００３１】また、この発明の第２の目的は、宛先無線端末がパワーセーブモードで動作しているとき直接転送方法によるパケット転送が行われると受信されないという問題点を解決し、高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができる無線パケット転送方法を提供することにある。
【００３２】また、この発明の第３の目的は、宛先無線端末が認証が成功しないとき直接転送方法によりパケットを送信すると宛先無線端末側で廃棄されるという問題点を解決し、高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができる無線パケット転送方法を提供することにある。
【００３３】また、この発明の第４の目的は、ブロードキャストパケットを直接転送方法により転送したとき、直接転送が可能な位置に所在していない無線端末がブロードキャストパケットを受信できないという問題を解決し、ブロードキャストパケットの転送を高い信頼性で行うことができる無線パケット転送方法を提供することにある。
【００３４】また、この発明の第５の目的は、ある宛先無線端末に対して直接転送方法によりパケット転送を行っている送信元無線端末が無線基地局の切り替えを行った場合において、当該送信元無線端末が切り替え前と同じ宛先無線端末に対して直接転送方法によりパケット転送を行うと転送が失敗に終わる場合があるという問題点を解決し、高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができる無線パケット転送方法を提供することにある。
【００３５】また、この発明の第６の目的は、フラグメント分割方法を適用した場合におけるスループットの改善効果の劣化の問題点を解決し、高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができる無線パケット転送方法を提供することにある。
【００３６】また、この発明の第７の目的は、ＲＴＳ／ＣＴＳランダムアクセス方法を適用した場合におけるスループットの改善効果の劣化の問題点を解決し、高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができる無線パケット転送方法を提供することにある。
【００３７】
【課題を解決するための手段】上記第１の目的を達成するためには、直接転送方法によるパケット転送が成功する可能性が高い無線端末のみを対象として、直接転送方法によるパケット転送を行い、直接転送方法によるパケット転送が失敗する可能性がある無線端末については予め直接転送方法の適用対象から除外する手段が望まれる。
【００３８】また、一般に無線端末は移動し得るものであるため、ある時点において宛先無線端末に対して行った直接転送が成功したとしても、その後の別の時点において同じ宛先無線端末に対して行う直接転送が成功するとは限らない。逆に、ある時点において宛先無線端末に対して行った直接転送が失敗したとしても、その後の別の時点において同じ宛先無線端末に対して行う直接転送が成功する場合もある。すなわち、直接転送方法によるパケット転送が成功する可能性が高い無線端末とは、固定されたものではないのである。
【００３９】従って、ある無線端末が直接転送方法によるパケット転送が成功する可能性が高い無線端末となった場合にはこれを直ちに直接転送方法の適用対象に含め、ある無線端末が直接転送方法によるパケット転送が失敗する可能性が高い無線端末となった場合にはこれを直ちに直接転送方法の適用対象から除外する何等かの手段が望まれるのである。
【００４０】請求項１に係る発明は、このような考えに従ってなされたものであり、無線端末が他の無線端末に

宛ててパケットを送信する場合に、当該送信元無線端末が無線基地局に対してパケットを送信し、当該無線基地局が当該宛先無線端末に当該パケットを送信する中継転送方法、または、当該送信元無線端末が当該宛先無線端末に当該パケットを直接送信する直接転送方法のいずれかを選択し、選択した方法により当該パケットの転送を行い、前記宛先無線端末および前記無線基地局は前記パケットを誤りなく受信した場合に応答信号を送信し、前記送信元無線端末は、前記パケットの送信後一定期間内に前記応答信号を受信した場合にはパケット送信完了と判断し、前記パケットの送信後一定期間内に前記応答信号を受信しない場合にはパケット送信不完了と判断して当該パケットの再送を行う無線パケット転送方法において、　前記無線端末は、

ａ．前記直接転送方法の適用が可能な無線端末を特定する直接転送テーブルを記憶し、

ｂ．任意の他の無線端末宛てにパケットを転送するとき、当該宛先無線端末が前記直接転送テーブルに登録されていない場合には前記中継転送方法によりパケットの転送を行い、当該宛先無線端末が前記直接転送テーブルに登録されている場合には前記直接転送方法によりパケットの転送を行い、

ｃ．任意の無線端末宛てに送信されたパケットの自局における受信状況に基づき、当該パケットの送信元無線端末が前記直接転送テーブルに登録されるための登録条件を満たすか否かの判定を行い、当該登録条件を満たす場合に当該送信元無線端末を前記直接転送テーブルに登録し、

ｄ．自局が前記直接転送テーブルに登録された無線端末宛てにパケットを送信した場合の送信結果または任意の無線端末から当該無線端末宛てに送信したパケットを自局が受信した場合の受信状況の少なくとも一方に基づき、前記直接転送テーブルにおける当該無線端末の登録を抹消するための登録抹消条件を満たすか否かの判定を行い、当該登録抹消条件を満たす場合に前記直接転送テーブルにおける当該無線端末の登録を抹消することを特徴とする無線パケット転送方法を要旨とする。

【００４１】かかる発明によれば、直接転送方法によるパケット転送を行った場合に成功する可能性の高い無線端末のみを直接転送テーブルに登録することができ、この登録した無線端末のみを対象として、直接転送方法によるパケット転送を試みることができる。

【００４２】本発明において、「パケット転送を行った場合に成功する可能性の高い無線端末」か否かは、当該無線端末から「任意の無線端末宛てに送信されたパケットの自局における受信状況」に基づいて判定される。すなわち、ある無線端末から送信されたパケットの自局における受信状況が良好なものである場合には、自局から直接転送方法により当該無線端末にパケットを転送した場合にも当該無線端末側では良好な受信状況でパケットの受信が行われるはずである。そこで、パケットの受信状況が良好である場合には当該パケットの送信元無線端末が上記「登録条件」を満たすと判定し、直接転送テーブルに登録するのである。

【００４３】何を以て「受信状況」が良好であるとするかについては、様々な基準が考えられるが、例えばパケットの受信レベルが十分に大きいこと、あるいは十分な受信レベルで受信が行われる頻度が高いこと、あるいは受信データの誤り率が低いこと等が挙げられる。

【００４４】また、本発明において、ある無線端末を直接転送テーブルに登録するか否かの判定は、自局宛てのパケットのみならず、他の無線端末をも含む「任意の無線端末宛てに送信されたパケット」の受信状況に基づいて行われる。従って、本発明によれば、ある無線端末が上記「登録条件」を満たすものとなった場合に、極力早期に直接転送テーブルへの登録を行うことができる。

【００４５】また、無線端末の移動等により、一旦、直接転送テーブルに登録された無線端末が直接転送方法の適用対象として相応しいものでなくなる場合があり、かかる場合には直接転送テーブルにおける当該無線端末の登録を抹消する必要がある。この登録抹消の契機となるのが、上記「登録抹消条件」を満たすか否かの判定であり、かかる判定は「自局が前記直接転送テーブルに登録された無線端末宛てにパケットを送信した場合の送信結果または任意の無線端末から当該無線端末宛てに送信したパケットを自局が受信した場合の受信状況の少なくとも一方」に基づき行われる。

【００４６】本発明においては、以上のような直接転送テーブルに対する登録および登録抹消の手続が随時行われることにより、直接転送方法によるパケット転送を行った場合に成功する可能性が高い無線端末が常に直接転送テーブルに登録され、この登録された無線端末のみを対象として直接転送方法によるパケット転送が行われることとなるのである。

【００４７】従って、本発明によれば、直接転送方法によるパケット転送が失敗に終わる可能性が低く、その一方、可能な限り直接転送方法によるパケット転送を行うことができ、高いスループットが得られ、かつ、可能な限り短い転送時間でパケット転送を行うことができる。

【００４８】さて、上述したように「受信状況」に基づく「登録条件」を満たすか否かの判定は、各種の方法により行うことができるが、例えば以下の方法が最も簡便かつ的確な方法と考えられる。

【００４９】❶ 無線端末は、任意の無線端末宛てに送信されたパケットを、同一の送信元無線端末で閾値Ｌ１以上の受信レベルで、連続ｍ１回受信した場合に、その送信元である無線端末が前記登録条件を満たすものと判定する（請求項２）。

❷ 任意の無線端末宛てに送信されたパケットを、同一の送信元無線端末で閾値Ｌ１以上の受信レベルで、Ｐ１回

中Ｑ１回（Ｐ１≧Ｑ１）受信したとき、その送信元である無線端末が前記登録条件を満たすものと判定する（請求項３）。

⑬ 任意の無線端末宛てに送信されたパケットを、同一の送信元無線端末で閾値Ｌ１以上の受信レベルで、連続ｍ１回またはＰ１回中Ｑ１回（Ｐ１≧Ｑ１）受信したとき、その送信元である無線端末が前記登録条件を満たすものと判定する（請求項４）。

【００５０】上記各方法によれば、上記閾値Ｌ１を所要パケット誤り率を満足する受信レベルとすることにより、自局が直接転送方法によりパケットを転送した場合に所要パケット誤り率を満たす通信品質で転送し得る無線端末のみを直接転送テーブルに登録し、直接転送方法の適用対象とすることができる。

【００５１】また、上記「登録抹消条件を満たすか否かの判定」の方法も、各種の方法が考えられるが、例えば以下のものが簡便かつ的確な方法と考えられる。

【００５２】⑭ 前記直接転送方法によりパケットの転送を行い、同一の送信元無線端末が連続ｍ２回、パケット送信不完了と判断した場合に、その宛先である無線端末が前記登録抹消条件を満たすものと判定する（請求項５）。

⑮ 前記直接転送方法によりパケットの転送を行い、同一の送信元無線端末がＰ２回中Ｑ２回（Ｐ２≧Ｑ２）、パケット送信不完了と判断した場合に、その宛先である無線端末が前記登録抹消条件を満たすものと判定する（請求項６）。

⑯ 前記直接転送方法によりパケットの転送を行い、同一の送信元無線端末が連続ｍ２回あるいはＰ２回中Ｑ２回（Ｐ２≧Ｑ２）、パケット送信不完了と判断した場合に、その宛先である無線端末が前記登録抹消条件を満たすものと判定する（請求項７）。

【００５３】⑰ 前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを、同一の送信元無線端末が閾値Ｌ２未満の受信レベルで、連続ｍ３回受信したとき、その送信元である無線端末が前記登録抹消条件を満たすものと判定する（請求項８）。

⑱ 前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを、同一の送信元無線端末が閾値Ｌ２未満の受信レベルで、Ｐ３回中Ｑ３回（Ｐ３≧Ｑ３）受信したとき、その送信元である無線端末が前記登録抹消条件を満たすものと判定する（請求項９）。

⑲ 前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを、同一の送信元無線端末が閾値Ｌ２未満の受信レベルで、連続ｍ３回あるいはＰ３回中Ｑ３回（Ｐ３≧Ｑ３）受信したとき、その送信元である無線端末が前記登録抹消条件を満たすものと判定する（請求項１０）。

【００５４】⑳ 一定期間、前記直接転送テーブルに登録された無線端末が任意の無線端末宛てに送信したパケットを受信せず、かつ、当該登録された無線端末に対してパケットの転送を行ってパケット送信完了となることが１回もないとき、当該登録された無線端末が前記登録抹消条件を満たすものと判定する（請求項１１）。

【００５５】上記各方法を採用した場合の効果について説明すると次の通りである。

【００５６】直接転送に失敗した場合、その直後に同じ宛先無線端末に直接転送を行ったとしても失敗する可能性が極めて高い。上記① ～⑳ によれば、そのような直接転送に失敗する可能性が極めて高い無線端末の登録を抹消し、直接転送の対象から除外することができる。

【００５７】上記㉑ ～㉓ を採用した場合には、登録条件の判定に使用する閾値Ｌ１と登録抹消条件の判定に使用する閾値Ｌ２を調整することにより以下の特有の効果が得られる。まず、Ｌ１＝Ｌ２とすると、直接転送テーブルに登録された無線端末が直接転送時に所要の品質を満たさない位置に移動したとき、登録を抹消し、中継転送方法に切り替えることにより、通信品質を維持し、スループットを高めることができる。また、Ｌ２を所要のパケット誤り率を満足する受信レベルとし、Ｌ１＞Ｌ２とすると、直接転送と中継転送の切り替え頻度を抑制することができ、切り替えに伴う処理負荷によって無線端末に与えられる影響を抑制することができる。

【００５８】上記㉔ を採用した場合には、直接転送が可能な位置から遠くに離れてしまった可能性の高い無線端末の直接転送テーブルにおける登録を抹消し、当該無線端末については中継転送に切り替えるため、無駄なパケット転送を防止し、スループットを高めることができる。

【００５９】なお、以上説明した登録抹消条件に関する各判定方法は、判定の正確さを高めるため、複数種類のものを併用してもよい。

【００６０】次に、請求項１２に係る発明は、前記無線端末は、受信機の起動と停止を周期的に繰り返すパワーセーブモードにおける前記受信機の起動と停止の周期を予め前記無線基地局に通知し、通信中に、前記受信機を起動状態のまま維持するアクティブモードから前記パワーセーブモードへ、あるいは逆に前記パワーセーブモードから前記アクティブモードへの切り換えを行う場合には前記無線基地局にモード切り換えの通知を行い、他の無線端末宛てにパケットの転送を行う場合において当該宛先無線端末が前記パワーセーブモードにある場合には、前記直接転送テーブルに当該宛先無線端末が登録されているか否かに拘わらず、前記中継転送方法により当該パケットの転送を行うことを特徴とする請求項１～１１のいずれか１の請求項に記載の無線パケット転送方法を要旨とする。

【００６１】かかる発明によれば、宛先無線端末がパワーセーブモードで動作しているときは、当該宛先無線端

末がたとえ直接転送テーブルに登録されていたとしても、中継転送方法が適用される。従って、本発明によれば、上記請求項１～１２に係る発明の効果に加え、パワーセーブモードで動作している宛先無線端末に直接転送方法によるパケット転送を行って失敗するという事態を避けることができ、スループットの向上を図ることができるという効果が得られる。

【００６２】請求項１３に係る発明は、前記無線端末は、他の無線端末にパケットを転送するときに、当該他の無線端末との間で認証を行い、認証に成功しない場合には、当該他の無線端末が前記直接転送テーブルに登録されているか否かに拘わらず、前記中継転送方法により、当該他の無線端末へのパケット転送を行うことを特徴とする請求項１～１２のいずれか１の請求項に記載の無線パケット転送方法を要旨とする。

【００６３】宛先無線端末が認証を拒否したとき直接転送方法によりパケットを送信すると宛先無線端末側で廃棄されるという問題点が解決され、これにより高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができる。

【００６４】請求項１４に係る発明は、前記無線端末は、ブロードキャストによるパケットの転送を行う場合には、前記中継転送方法により当該パケットの転送を行うことを特徴とする請求項１～１３のいずれか１の請求項に記載の無線パケット転送方法を要旨とする。

【００６５】かかる発明によれば、ブロードキャストパケットを転送するときは、中継転送方法が適用され、ユニキャストパケットを転送するときは請求項１～１３に係る方法に従うこととなる。従って、本発明によれば、上記請求項１～１３に係る発明の効果に加え、直接転送を行った場合にブロードキャストパケットを受信できない無線端末に対しても中継転送によりパケット転送を行うことができ、パケット転送を信頼性を高めることができるという効果が得られる。

【００６６】請求項１５に係る発明は、前記無線端末は、前記無線基地局のサービスエリアの圏内に位置するか圏外に位置するかを検出し、前記無線基地局のサービスエリアの圏外に位置する場合には前記直接転送方法によりパケットの転送を行うことを特徴とする請求項１～１４のいずれか１の請求項に記載の無線パケット転送方法を要旨とする。

【００６７】かかる発明によれば、無線端末が無線基地局のサービスエリアの圏外に位置する場合には、宛先無線端末が直接転送テーブルに登録されているか否かに拘わらず、直接転送方法によりパケットの転送を行うので、中継転送方法による無駄なパケット転送を防止することができ、スループットの向上とパケット転送時間の短縮を図ることができるという効果が得られる。

【００６８】請求項１６に係る発明は、前記無線端末は、在圏先である無線基地局の切り替えに伴って、前記直接転送テーブルにおける全ての無線端末の登録を抹消することを特徴とする請求項１～１５のいずれか１の請求項に記載の無線パケット転送方法を要旨とする。

【００６９】従来技術においては、ある宛先無線端末に対して直接転送方法によりパケット転送を行っている送信元無線端末が無線基地局の切り替えを行った場合において、当該送信元無線端末が切り替え前と同じ宛先無線端末に対して直接転送方法によりパケット転送を行うと転送が失敗に終わる場合があるという問題があったが、本発明によれば、無線基地局の切り替えを行った後は、まず、中継転送方法が適用されるため、この問題を解決することができる。

【００７０】請求項１７に係る発明は、無線基地局と複数の無線端末で無線パケット通信を行い、無線端末がパケットを送信するとき、当該パケットのパケット長が予め設定されたフラグメント閾値を越える場合には、パケット長が前記フラグメント閾値以下となるように当該パケットを分割して送信する無線パケット転送方法において、前記無線端末は、前記無線基地局に対してパケットを送信し、当該無線基地局が宛先無線端末に当該パケットを送信する中継転送方法によるパケット転送を行う場合と、当該宛先無線端末に当該パケットを直接送信する直接転送方法によるパケット転送を行う場合とで各々別個のフラグメント閾値を使用することを特徴とする無線パケット転送方法を要旨とする。

【００７１】かかる発明によれば、中継転送方法の場合と直接転送方法の場合とで各々に適したフラグメント閾値を使用することができるので、スループットの向上を図ることができる。

【００７２】請求項１８に係る発明は、無線基地局と複数の無線端末で無線パケット通信を行い、無線端末がパケットを送信するとき、当該パケットのパケット長が予め設定されたＲＴＳ閾値を越える場合には、ＲＴＳ信号に自局の識別子と前記パケット長を付与して宛先無線端末または前記無線基地局に送信し、前記宛先無線端末または前記無線基地局は、前記ＲＴＳ信号の送信元無線端末による前記パケットの転送を許可する場合には、当該ＲＴＳ信号に付与された識別子およびパケット長を各々許可アドレスおよび予約期間としてＣＴＳ信号に付与して送信し、ＲＴＳ信号の送信を行った無線端末は、自局のアドレスを許可アドレスとして含むＣＴＳ信号を受信した場合に前記パケットを送信し、自局のアドレスを許可アドレスとして含まないＣＴＳ信号を受信した場合には当該ＣＴＳ信号に付与された予約期間に相当する期間が終了するまでＲＴＳ信号およびパケットの送信を見送る無線パケット転送方法において、前記無線端末は、前記無線基地局に対してパケットを送信し、当該無線基地局が宛先無線端末に当該パケットを送信する中継転送方法によるパケット転送を行う場合と、当該宛先無線端末に当該パケットを直接送信する直接転送方法によるパケ

ット転送を行う場合とで各々別個のＲＴＳ閾値を使用することを特徴とする無線パケット転送方法を要旨とする。

【００７３】かかる発明によれば、中継転送方法の場合と直接転送方法の場合とで各々に適したＲＴＳ閾値を使用することができるので、スループットの向上を図ることができる。

【００７４】

【発明の実施の形態】以下、図面を参照し、本発明の実施の形態について説明する。

【００７５】Ａ．本発明の各実施形態が適用されるネットワークの構成例

図１は、本発明の各実施形態が適用されるネットワークの構成例を示すものである。このネットワークにおいて、各無線基地局１０、１０、…は、複数の無線端末を収容する。無線基地局１０と有線端末２０は、イーサネット３０により接続されている。無線端末１、２、３、４、…とホスト（図示略）との通信はいずれかの無線基地局を介して行われる。また、無線基地局１０、１０、…は、自局が収容する無線端末のＭＡＣアドレスを収容端末テーブル１１に各々記憶する。

【００７６】Ｂ．第１の実施形態

本実施形態は、請求項１に係る無線パケット転送方法を実施する無線パケット転送システムの実施形態であって、上記「登録条件」に関する判定を請求項２に係る発明に従って行い、上記「登録抹消条件」に関する判定を請求項５に係る発明に従って行うものである。

【００７７】図２は本実施形態において無線端末と無線端末との間および無線端末と無線基地局との間で授受される無線パケットのフォーマットを示すものであり、図２（ａ）はデータパケットのフォーマットを、図２（ｂ）はＡＣＫ信号（応答信号）のフォーマットを示している。図２（ａ）に示すように、データパケットは、ヘッダと、データと、フレームチェックシーケンスＦＣＳとによって構成されている。

【００７８】そして、ヘッダは、宛先アドレスＤＡと、送信元アドレスＳＡと、パケット種別（データパケットの場合はパケット種別は“００００”）と、転送種別とを含んでいる。

【００７９】ここで、宛先アドレスＤＡは、宛先の無線端末または有線端末のＭＡＣアドレスである。また、送信元アドレスＳＡは、送信元の無線端末または有線端末のＭＡＣアドレスである。また、転送種別は、当該パケットの転送方法を特定する情報であり、当該パケットが直接転送方法を実施すべく無線端末から送信されるものである場合には“００”とされ、中継転送方法を実施すべく無線端末から送信されるものであるの場合には“０１”とされ、中継転送方法を実施すべく無線基地局から送信される場合には“１０”とされる。

【００８０】また、ＡＣＫ信号は、図２（ｂ）に示すように、宛先アドレスＤＡと、パケット種別（ＡＣＫ信号の場合はパケット種別は“０００１”）と、フレームチェックシーケンスＦＣＳとにより構成されている。

【００８１】図３は、本実施形態における無線端末のデータパケットの受信動作の例を示すフローチャートである。本実施形態において各無線端末は、図４に例示する直接転送テーブルを記憶している。この直接転送テーブルは、当該無線端末から直接転送方法によりパケット転送を行うことが可能であると判定された無線端末のＭＡＣアドレスを構成要素とするものである。本実施形態における無線端末の受信動作では、この直接転送テーブルに対する無線端末のＭＡＣアドレスの登録が行われる。この動作例では、直接転送テーブルに対し無線端末を登録を行うか否かの「登録条件」についての判定は、請求項２に係る発明においてｍ１＝１とした方法を採用している。勿論、ｍ１を２以上としてもよく、そのような態様で実施し得るように図３のフローを変更することは当業者であれば容易に成し得ることである。以下、図３に示すフローを参照し、その詳細について説明する。

【００８２】無線端末はデータパケットを受信すると、まず、フレームチェックシーケンスＦＣＳが正常か否かを判定する（ステップＳ１０１）。この判断結果が「ＮＯ」である場合には当該パケットを廃棄（ステップＳ１１０）後、受信処理を終了し、「ＹＥＳ」である場合にはステップＳ１０２へ進む。

【００８３】次にステップＳ１０２に進むと、受信したデータパケットの転送種別が“１０”か否かを判断し、転送種別が“１０”である場合にはステップＳ１０６に進み、“１０”でない場合にはステップＳ１０３に進む。

【００８４】次にステップＳ１０３に進むと、当該データパケットの受信レベルが閾値Ｌ１以上であるか否かを判断し、この判断結果が「ＮＯ」である場合にはステップＳ１０６に進み、「ＹＥＳ」の場合にはステップＳ１０４に進む。

【００８５】次にステップＳ１０４に進むと、当該データパケットの送信元アドレスが直接転送テーブルに登録されているか否かを判断し、この判断結果が「ＹＥＳ」の場合にはステップＳ１０６に進み、「ＮＯ」の場合はステップＳ１０５に進む。次にステップＳ１０５に進むと、当該データパケットの送信元アドレスを直接転送テーブルに登録する。そして、ステップＳ１０６に進む。

【００８６】このように、データパケットの受信が行われた場合には、その転送種別が“００”または“０１”であり（すなわち、当該データパケットが他の無線端末から直接転送方法または中継転送方法により送信されたものであり）、かつ、その受信レベルが閾値Ｌ１以上である場合に、当該データパケットの送信元である無線端末のアドレスが直接転送テーブルに登録されるのである。この場合、登録は、当該データパケットが自局宛て

のものであるか他の無線端末等に宛てたものであるかの如何に拘わらず行われる。

【００８７】次にステップＳ１０６に進むと、当該データパケットの宛先アドレスが自局のアドレスと一致しているか否かを判断する。この判断結果が「ＮＯ」の場合は当該パケットを廃棄（ステップＳ１１０）後、受信処理を終了し、「ＹＥＳ」である場合にはステップＳ１０７へ進む。

【００８８】次にステップＳ１０７に進むと、当該データパケットの転送種別が“０１”か否かを判断する。この判断結果が「ＹＥＳ」の場合は当該パケットを廃棄（ステップＳ１１０）後、受信処理を終了する。当該パケットは、他の無線端末から自局へ宛てて送信されたものではあるが、中継転送方法により自局まで転送されるべきものであり、無線基地局経由で受信するのが正常な受信形態だからである。

【００８９】一方、ステップＳ１０７の判断結果が「ＹＥＳ」の場合、すなわち、当該データパケットが他の無線端末から自局宛てに直接転送されたものである場合（転送種別“００”）または当該データパケットが他の無線端末から無線基地局経由で自局宛てに中継転送されたものである場合（転送種別“１０”）にはステップＳ１０８に進む。

【００９０】次にステップＳ１０８に進むと、ＡＣＫ信号の送信を行う。ここで、受信したデータパケットが直接転送方法により他の無線端末から送信されたものである場合（転送種別“００”）には、当該データパケットの送信元である無線端末宛てにＡＣＫ信号の送信を行い、当該データパケットが中継転送方法により無線基地局から送信されたものである場合（転送種別“１０”）には、無線基地局宛てにＡＣＫ信号の送信を行う。

【００９１】次にステップＳ１０９に進むと、受信したデータパケットを上位レイヤに渡し、受信処理を終了する。

【００９２】以上説明した本実施形態に係る受信動作において、閾値Ｌ１を所要品質を満足する受信レベルとすることにより、直接転送時の品質を満たす無線端末に対しては直接転送、品質を満たさない無線端末に対しては中継転送を選択することが可能となる。

【００９３】次に図５に示すフローチャートを参照し、本実施形態における無線端末のデータパケットの送信動作について説明する。この送信動作は、直接通信テーブルにおける無線端末の登録を抹消する処理を含んでいるが、ある無線端末の登録を抹消するか否かの「登録抹消条件」に関する判定方法として請求項５に係る判定方法を採用している。

【００９４】まず、無線端末では、データパケットの送信要求が生じると、まず、内蔵のリトライカウンタを「１」に設定する（ステップＳ２０１）。次に当該データパケットの宛先アドレスが直接転送テーブルに登録されているか否かを判断する（ステップＳ２０２）。この判断結果が「ＹＥＳ」の場合はステップＳ２０３へ進み、「ＮＯ」の場合はステップＳ２１０へ進む。

【００９５】次にステップＳ２０２からステップＳ２０３へ進むと、直接転送方法を選択する。次にステップＳ２０４へ進み、直接転送方法に対応した転送種別“００”をデータパケットに設定し、当該データパケットを送信する。

【００９６】次にステップＳ２０５に進み、宛先の無線端末からのＡＣＫ信号を受信したか否かを判断する。この判断結果が「ＹＥＳ」の場合は、送信したデータパケットが宛先無線端末によって正常に受信されたとみなし、送信動作を終了する。

【００９７】これに対し、ステップＳ２０５の判断結果が「ＮＯ」である場合にはステップＳ２０６へ進み、リトライカウンタの値が所定の閾値ｍ２よりも小さいか否かを判断する。そして、この判断結果が「ＹＥＳ」である場合には、リトライカウンタの値を「１」だけ増加させ（ステップＳ２０７）、ランダムに決定される待機時間だけ待機し（ステップＳ２０８）、再びデータパケットの送信を行う（ステップＳ２０４）。以下、同様に、宛先端末からＡＣＫ信号が受信されず、かつ、リトライカウンタの値がｍ２未満である場合には、ステップＳ２０７、Ｓ２０８およびステップＳ２０４を繰り返す。

【００９８】そして、ＡＣＫ信号が受信されることなく、リトライカウンタの値が閾値ｍ２に達した場合にはステップＳ２０６からステップＳ２０９に進む。このステップＳ２０９に進むと、送信対象であるデータパケットの宛先アドレスを直接転送テーブルから削除する。そのような宛先アドレスの無線端末に対しては、直接転送方法によるパケット転送をするのが困難であると考えられるからである。このステップＳ２０９の処理が終了すると、ステップＳ２１０へ進む。なお、既に説明したように、上記ステップＳ２０９の処理を経た場合の他、当該データパケットの宛先アドレスが直接転送テーブルに登録されていない場合にもステップＳ２１０へ進むこととなる。

【００９９】次にステップＳ２１０に進むと、中継転送方法を選択する。次にステップＳ２１１へ進み、中継転送方法に対応した転送種別“０１”をデータパケットに設定し、当該データパケットを送信する。

【０１００】次にステップＳ２１２に進み、宛先の無線基地局からのＡＣＫ信号を受信したか否かを判断する。この判断結果が「ＹＥＳ」の場合は、送信したデータパケットが正常に受信されたとみなし、送信動作を終了する。

【０１０１】これに対し、ステップＳ２１２の判断結果が「ＮＯ」である場合にはステップＳ２１３へ進み、リトライカウンタの値が所定の最大再送回数Ｎ（ただし、Ｎ＞ｍ２である。）よりも小さいか否かを判断する。そ

して、この判断結果が「ＹＥＳ」である場合には、リトライカウンタの値を「１」だけ増加させ（ステップＳ２１４）、ランダムに決定される待機時間だけ待機し（ステップＳ２１５）、再びデータパケットの送信を行う（ステップＳ２１１）。以下、同様に、宛先である無線基地局からＡＣＫ信号が受信されず、かつ、リトライカウンタの値がＮ未満である場合には、ステップＳ２１４、Ｓ２１５およびステップＳ２１１を繰り返す。

【０１０２】そして、ＡＣＫ信号が受信されることなく、リトライカウンタの値が最大再送回数Ｎに達した場合には、ステップＳ２１３からステップＳ２１６に進んで送信データパケットを廃棄し、送信処理を終了する。

【０１０３】以上説明した無線端末におけるデータパケットの送信動作によれば、送信元無線端末の通信中に宛先無線端末が見通し外等の直接転送が不可能な位置に移動した場合でも、当該宛先無線端末に適用するパケット転送の方法を直接転送方法から中継転送方法へ変更することができる。

【０１０４】次の図６に示すフローチャートを参照し、本実施形態における無線基地局のパケット中継動作について説明する。まず、無線基地局は、無線端末から送信されたデータパケットであって転送種別が“０１”であるもの（すなわち、中継転送方法を実施すべく無線端末から送信されたデータパケット）を受信すると、送信元である無線端末に対してＡＣＫ信号を送信し（ステップＳ３０１）、受信したデータパケットの宛先が当該無線基地局に収容される無線端末であるか否かを判断する（ステップＳ３０２）。また、無線基地局は、有線端末から送信されたデータパケットを受信した場合にも、当該データパケットの宛先が当該無線基地局に収容される無線端末であるか否かの判断を行う（ステップＳ３０２）。

【０１０５】このステップＳ３０２の判断結果が「ＮＯ」の場合にはパケット中継動作を行うことなく処理を終了する。

【０１０６】これに対し、ステップＳ３０２の判断結果が「ＹＥＳ」である場合、すなわち、上記無線端末または有線端末から受信したデータパケットの宛先が当該無線基地局に収容されている無線端末である場合には、当該データパケットを当該宛先無線端末に転送する中継動作を以下の手順により実行する。

【０１０７】まず、ステップＳ３０３に進み、リトライカウンタの値を「１」とする。次にステップＳ３０４に進み、中継転送方法を実施すべく無線基地局から送信されたデータパケットであることを表示する転送種別“１０”を当該データパケットに設定し、当該宛先無線端末宛てに送信する。

【０１０８】次にステップＳ３０５に進み、宛先無線端末からのＡＣＫ信号を受信したか否かを判断する。この判断結果が「ＹＥＳ」の場合は、送信したデータパケットが正常に受信されたとみなし、中継動作を終了する。

【０１０９】これに対し、ステップＳ３０５の判断結果が「ＮＯ」である場合にはステップＳ３０６へ進み、リトライカウンタの値が所定の最大再送回数Ｎよりも小さいか否かを判断する。そして、この判断結果が「ＹＥＳ」である場合には、リトライカウンタの値を「１」だけ増加させ（ステップＳ３０７）、ランダムに決定される待機時間だけ待機し（ステップＳ３０８）、再びデータパケットの送信を行う（ステップＳ３０４）。以下、同様に、宛先無線端末からＡＣＫ信号が受信されず、かつ、リトライカウンタの値がＮ未満である場合には、ステップＳ３０７、Ｓ３０８およびステップＳ３０４を繰り返す。

【０１１０】そして、ＡＣＫ信号が受信されることなく、リトライカウンタの値が最大再送回数Ｎに達した場合には、ステップＳ３０６からステップＳ３０９に進んで当該データパケットを廃棄し、中継処理を終了する。

【０１１１】以上説明した無線基地局の動作により、無線端末から他の無線端末へのデータパケットの中継転送および有線端末から無線端末へのパケット中継が可能となるのである。

【０１１２】次に図７～図１２は、本実施形態における各種の動作例を示すものである。以下、これらの図を参照し、本実施形態の具体的動作例について説明する。

【０１１３】まず、図７の動作シーケンス図は、ある無線端末Ｂが直接転送テーブルに登録された無線端末Ａ宛てにデータパケットを送信する場合の動作例を示している。この動作例では、無線端末Ｂの直接転送テーブルには無線端末Ａが登録されている。このため、無線端末Ｂは、無線端末Ａ宛てに転送すべきデータパケットが発生した場合に、当該データパケットの転送種別を“００”とし、かつ、宛先アドレスを無線端末ＡのＭＡＣアドレスとし、直接転送方法により送信する。

【０１１４】無線端末Ａは、このデータパケットを受信すると、その受信レベルが閾値Ｌ１以上であるか否かを判断し、閾値Ｌ１未満である場合には直接転送テーブルへの登録は行わない。これに対し、受信レベルが閾値Ｌ１以上である場合には、送信元である無線端末ＢのＭＡＣアドレスを直接転送テーブルに登録する。さらに、受信したデータパケットは無線端末ＡのＭＡＣアドレスを宛先アドレスとするものであることから、当該データパケットを上位レイヤに引き渡すとともに、当該データパケットの送信元である無線端末Ｂ宛てにＡＣＫ信号を送信する。

【０１１５】無線端末Ｂ側では、このＡＣＫ信号の受信により、上記データパケットの送信が成功したことを認識し、送信処理を終了する。

【０１１６】以上説明したように、本実施形態によれば、直接転送テーブルに登録されている無線端末については、無線基地局を経由しない直接転送方法により宛先

無線端末にデータパケットが転送されるので、中継のオーバヘッドを削減するとともに転送の所要時間を短くすることができる。

【０１１７】次に、図８の動作シーケンス図は、無線端末Ａが直接転送テーブルに登録された無線端末Ｃ宛てにデータパケットを送信した場合において、第三者たる無線端末Ｂがこの無線端末Ｃ宛てのデータパケットを受信し、無線端末Ａを直接転送テーブルに登録する場合の動作例を示している。

【０１１８】この動作例では、無線端末Ａの直接転送テーブルには無線端末Ｃが登録されている。このため、無線端末Ａは、無線端末Ｃ宛てに転送すべきデータパケットが発生した場合に、当該データパケットの転送種別を“００”とし、かつ、宛先アドレスを無線端末ＣのＭＡＣアドレスとし、直接転送方法により送信する。

【０１１９】無線端末Ｃは、このデータパケットを受信すると、ＡＣＫ信号を無線端末Ａ宛てに送信する。無線端末Ａは、このＡＣＫ信号を受信することにより、パケットデータの送信が成功したことを認識し、送信処理を終了する。

【０１２０】一方、無線端末Ａにとって見通しのよい所に無線端末Ｂが位置している場合には、無線端末Ａから送信された無線端末Ｃ宛てのデータパケットが第三者たる無線端末Ｂによって受信されることがある。この場合、無線端末Ｂは、データパケットの受信レベルが閾値Ｌ１以上か否かを判断し、閾値Ｌ１以上である場合には、受信したデータパケットの送信元である無線端末ＡのＭＡＣアドレスを直接転送テーブルに登録する。また、受信したデータパケットは無線端末Ｃ宛てのものであるから廃棄する。一方、受信レベルが閾値Ｌ１未満である場合には直接転送テーブルへの登録は行わない。

【０１２１】以上説明したように、本実施形態では、無線端末が他の無線端末宛てのデータパケットを受信したとき、その受信レベルが所定の閾値以上である場合に送信元である無線端末を直接転送テーブルに登録する。従って、直接転送の宛先とした場合に所定の通信品質で直接転送を行うことができる蓋念性の高い無線端末のみが直接転送テーブルに登録されることとなり、直接転送方法を実行した場合の失敗の頻度を少なくすることができる。

【０１２２】次に、図９の動作シーケンス図は、無線基地局を経由することにより無線端末Ａから無線端末Ｂへ中継転送が行われる場合の動作例を示している。この動作例において、無線端末Ａの直接転送テーブルには、無線端末ＢのＭＡＣアドレスは登録されていない。このため、無線端末Ａは、無線端末Ｂ宛てに送信すべきデータパケットが発生した場合に中継転送方法を選択し、宛先アドレスを無線端末ＢのＭＡＣアドレスとし、転送種別を“０１”として、当該データパケットを送信する。

【０１２３】無線基地局は、上記データパケットを受信すると、その転送種別が“０１”であるため、ＡＣＫ信号を無線端末Ａに送信する。

【０１２４】無線端末Ａは、このＡＣＫ信号を受信することにより、送信成功を認識し、送信処理を終了する。

【０１２５】一方、無線基地局は、上記データパケットの宛先が当該無線基地局に収容される無線端末Ｂであることから、当該データパケットの転送種別を“１０”として、当該データパケットの送信を行う。

【０１２６】無線端末Ｂは、このデータパケットを受信すると、その転送種別が“１０”であり、かつ、その宛先アドレスが自局のアドレスと一致しているため、当該データパケットを上位レイヤに引き渡し、ＡＣＫ信号を無線基地局に送信する。無線基地局は、このＡＣＫ信号を受信することによりデータパケットの送信成功を認識し、送信処理を終了する。

【０１２７】次に、図１０の動作シーケンス図は、無線端末Ａが直接転送テーブルに登録された無線端末Ｂへ直接転送方法によりデータパケットを転送するが、この転送に失敗し、中継転送方法に切り替える場合の動作例を示している。なお、この動作例ではｍ２＝１としている。

【０１２８】この動作例において、無線端末Ａの直接転送テーブルには、無線端末ＢのＭＡＣアドレスが登録されている。このため、無線端末Ａは、無線端末Ｂ宛てに送信すべきデータパケットが発生した場合に直接転送方法を選択し、宛先アドレスを無線端末ＢのＭＡＣアドレスとし、転送種別を“００”として、当該データパケットを送信する。

【０１２９】しかし、このとき例えば無線端末Ａの見通し外に無線端末Ｂが移動していると、上記データパケットの送信は失敗に終わることとなる。この場合、リトライカウンタの値が閾値ｍ２未満の期間はデータパケットの再送が行われるが、リトライカウンタの値が閾値ｍ２に達すると、無線端末Ａは直接転送テーブルにおける無線端末Ｂの登録を抹消する。

【０１３０】その後、無線端末Ａは、無線端末Ｂ宛てのデータパケットの転送種別を“０１”として送信する。

【０１３１】無線基地局は、上記データパケットを受信すると、その転送種別が“０１”であるため、ＡＣＫ信号を無線端末Ａに送信する。

【０１３２】無線端末Ａは、このＡＣＫ信号を受信することにより、送信成功を認識し、送信処理を終了する。

【０１３３】一方、無線基地局は、上記データパケットの宛先が当該無線基地局に収容される無線端末Ｂであることから、当該データパケットの転送種別を“１０”として、当該データパケットの送信を行う。

【０１３４】無線端末Ｂは、このデータパケットを受信すると、その転送種別が“１０”であり、かつ、その宛先アドレスが自局のアドレスと一致しているため、当該データパケットを上位レイヤに引き渡し、ＡＣＫ信号を

無線基地局に送信する。無線基地局は、このＡＣＫ信号を受信することによりデータパケットの送信成功を認識し、送信処理を終了する。

【０１３５】なお、以上説明した各動作例は、宛先無線端末と送信元無線端末が同じ無線基地局に収容されている場合のものであるが、図１１に例示するように、データパケットの授受を行う無線端末Ａと無線端末Ｂが隣接する２つの無線基地局に各々収容されている場合においても、上記と同様な直接転送テーブルの登録および登録抹消を行い、直接転送方法または中継転送方法によるパケット転送を行うことができる。

【０１３６】次に図１２の動作シーケンス図は、図１１における無線端末Ａから有線端末Ｚへパケット転送を行う場合の動作例を示している。まず、無線端末Ａにおいて、有線端末Ｚ宛てに送信すべきデータパケットが発生したとする。この場合、有線端末Ｚは無線端末Ａの直接転送テーブルに登録されていないので、無線端末Ａは、中継転送方法を選択し、宛先アドレスを有線端末ＺのＭＡＣアドレスとし、転送種別を“０１”として送信する。

【０１３７】無線基地局は、このデータパケットを受信すると、その転送種別が“０１”であることから、ＡＣＫ信号を送信元無線端末Ａに送信する。無線端末Ａは、このＡＣＫ信号の受信により送信成功を認識し、送信処理を終了する。

【０１３８】一方、無線基地局は、上記データパケットの宛先アドレスが当該無線基地局に収容される無線端末のものでないことから、当該データパケットをイーサネットパケットに変換し、イーサネットに送信する。

【０１３９】有線端末Ｚは、イーサネットを介して上記イーサネットパケットを受信すると、その宛先アドレスと自局のアドレスとが一致していることから、当該イーサネットパケットを上位レイヤに引き渡す。

【０１４０】以上説明したように、本実施形態によれば、宛先が有線端末である場合でも、直接転送による無駄な再送パケットを生じることなく、中継転送方法による有線端末宛てのパケット転送を行うことができる。

【０１４１】以上、請求項１に係る発明の実施形態を、「登録条件」に関する判定を請求項２に係る判定方法により行い、「登録抹消条件」に関する判定を請求項５に係る判定方法により行う場合を例に説明した。しかし、本実施形態において採用した「登録条件」や「登録抹消条件」に関する判定方法はあくまでも例示である。本発明を実施するに当っては、請求項２に係る判定方法の代りに請求項３または４に係る判定方法を採用してもよく、また、請求項５に係る判定方法の代りに請求項６または７に係る判定方法を採用してもよい。

【０１４２】Ｃ．第２の実施形態

本実施形態は、請求項１に係る無線パケット転送方法であって、「登録条件」に関する判定を請求項２に係る判定方法により行い、「登録抹消条件」に関する判定を請求項５に係る判定方法および請求項８に係る判定方法を併用して行うものである。

【０１４３】本実施形態において、無線端末と無線端末との間および無線端末と無線基地局との間で授受される無線パケットのフォーマットは、上記第１の実施形態と同様、前掲図２に示した通りである。また、上記第１の実施形態と同様、各無線端末は、前掲図４に例示する直接転送テーブルを記憶し、この直接転送テーブルの登録内容に従って、直接転送方法または中継転送方法の選択を行う。

【０１４４】図１３は、本実施形態における無線端末のデータパケットの受信動作を示すフローチャートである。この受信動作では、請求項２においてｍ１＝１とした判定方法により「登録条件」に関する判定を行い、請求項８においてｍ３＝１とした判定方法により「登録抹消条件」に関する判定を行う。勿論、ｍ１またはｍ３を２以上としてもよく、そのような態様で実施し得るように図１３のフローを変更することは当業者であれば容易に成し得ることである。

【０１４５】無線端末は、データパケットを受信すると、まず、当該データパケットのフレームチェックシーケンスＦＣＳが正常であるか否かを判断する（ステップＳ３０１）。そして、フレームチェックシーケンスＦＣＳが正常である場合にはステップＳ４０２に進む。なお、フレームチェックシーケンスＦＣＳに異常が認められる場合には、受信したデータパケットを廃棄し（ステップＳ４１３）、受信処理を終了する。

【０１４６】次にステップＳ４０２に進むと、受信したデータパケットの転送種別が“１０”であるか否かを判断する。この判断結果が「ＹＥＳ」の場合にはステップＳ４０９に進む。

【０１４７】これに対し、受信したデータパケットが直接転送方法を実施すべく無線端末から受信されたものである場合（転送種別＝“００”）または当該データパケットが中継転送方法を実施すべく無線端末から受信されたものである場合（転送種別＝“０１”）には、ステップＳ４０２の判断結果が「ＮＯ」となってステップＳ４０３に進むこととなる。

【０１４８】次にステップＳ４０３に進むと、当該データパケットの受信時の受信レベルが閾値Ｌ１以上であるか否かを判断する。この判断結果が「ＹＥＳ」である場合にはステップＳ４０４に進み、当該データパケットの送信元アドレスが当該無線端末の直接転送テーブルに登録されているか否かを判断する。そして、この判断結果が「ＮＯ」の場合には、当該送信元アドレスを直接転送テーブルに登録し（ステップＳ４０５）、ステップＳ４０９に進む。なお、上記ステップＳ４０４の判断結果が「ＹＥＳ」である場合には、直接転送テーブルへの登録（ステップＳ４０５）を実行することなくステップＳ４

０９へ進む。

【０１４９】一方、データパケットの受信レベルが閾値Ｌ１未満であった場合には、ステップＳ４０３からステップＳ４０６に進み、データパケットの受信レベルが閾値Ｌ２以上であるか否かを判断する。ここで、受信レベルが閾値Ｌ２以上である場合には、ステップＳ４０９に進む。これに対し、受信レベルが閾値Ｌ２未満である場合には、当該データパケットの送信元アドレスが当該無線端末の直接転送テーブルに登録されているか否かを判断する（ステップＳ４０７）。そして、この判断結果が「ＹＥＳ」である場合には、直接転送テーブルにおける当該送信元アドレスの登録を抹消し（ステップＳ４０８）、ステップＳ４０９に進む。なお、上記ステップＳ４０７の判断結果が「ＮＯ」である場合には、直接転送テーブルにおける登録抹消（ステップＳ４０８）を実行することなくステップＳ４０９へ進む。

【０１５０】このように、本実施形態においてデータパケットの受信が行われた場合には、その転送種別が“００”または“０１”であり（すなわち、当該データパケットが他の無線端末から直接転送方法または中継転送方法により送信されたものであり）、かつ、その受信レベルが閾値Ｌ１以上である場合に、当該データパケットの送信元無線端末が直接転送テーブルに登録される。また、転送種別が“００”または“０１”であるデータパケットの受信が行われ、そのときの受信レベルが閾値Ｌ２未満である場合に、直接転送テーブルにおける当該データパケットの送信元無線端末の登録が解除されるのである。この場合、登録および登録抹消は、当該データパケットが自局宛てのものであるか他の無線端末等に宛てたものであるかの如何に拘わらず行われる。

【０１５１】次にステップＳ４０９に進むと、当該データパケットの宛先アドレスが自局のアドレスと一致しているか否かを判断する。この判断結果が「ＮＯ」の場合は当該パケットを廃棄（ステップＳ４１３）後、受信処理を終了し、「ＹＥＳ」である場合にはステップＳ４１０へ進む。

【０１５２】次にステップＳ４１０に進むと、当該データパケットの転送種別が“０１”か否かを判断する。この判断結果が「ＹＥＳ」の場合は当該パケットを廃棄（ステップＳ４１３）後、受信処理を終了する。当該パケットは、他の無線端末から自局へ宛てて送信されたものではあるが、中継転送方法により自局まで転送されるべきものであり、無線基地局経由で受信するのが正常な受信形態だからである。

【０１５３】一方、ステップＳ４１０の判断結果が「ＮＯ」の場合、すなわち、当該データパケットが他の無線端末から自局宛てに直接転送されたものである場合（転送種別“００”）または当該データパケットが他の無線端末から無線基地局経由で自局宛てに中継転送されたものである場合（転送種別“１０”）にはステップＳ４１１に進む。

【０１５４】次にステップＳ４１１に進むと、ＡＣＫ信号の送信を行う。ここで、受信したデータパケットが直接転送方法により他の無線端末から送信されたものである場合（転送種別“００”）には、当該データパケットの送信元である無線端末宛てにＡＣＫ信号の送信を行い、当該データパケットが中継転送方法により無線基地局から送信されたものである場合（転送種別“１０”）には、無線基地局宛てにＡＣＫ信号の送信を行う。

【０１５５】次にステップＳ４１２に進むと、受信したデータパケットを上位レイヤに渡し、受信処理を終了する。

【０１５６】以上説明した本実施形態に係る受信動作において、閾値Ｌ１およびＬ２を所要品質を満足する受信レベルとすることにより、直接転送時の品質を満たす無線端末に対しては直接転送、品質を満たさない無線端末に対しては中継転送を選択することが可能となる。また、Ｌ１＞Ｌ２とすることにより、直接転送と中継転送の切り替え頻度を抑制することができる。従って、直接転送と中継転送の切り替えに伴う制御負荷が大きいときに無線端末に与える影響を抑制することができる。

【０１５７】図１４は、無線端末Ａが無線端末Ｂの直接転送テーブルに登録され、かつ、無線端末Ｂが無線端末Ａの直接転送テーブルに登録されている状態において、無線端末Ａから無線端末Ｂへ直接転送方法によるパケット転送が行われた場合の動作シーケンス例を示している。

【０１５８】この図１４に示すように、無線端末Ｂは、無線端末Ａからのパケットを受信すると、その受信レベルが閾値Ｌ２以上か否かを判断する。ここで、無線端末Ａと無線端末Ｂがそれまで直接転送方法による通信を行っていたが、無線端末Ｂが無線端末Ａから遠く離れたところに移動したような場合には、無線端末Ｂにおける上記受信レベルが閾値Ｌ２未満となることがある。このような場合、無線端末Ｂでは、当該パケットの送信元である無線端末Ａの直接転送テーブルにおける登録を抹消する。また、受信したパケットについては上位レイヤに引き渡し、ＡＣＫ信号を無線端末Ａ宛てに送信する。

【０１５９】このように本実施形態によれば、直接転送テーブルに登録された無線端末との相対的な位置関係が悪化する等の原因により、当該無線端末宛てに直接転送を行った場合の通信品質の低下が予想されるときには、直接転送テーブルにおける当該無線端末の登録が抹消され、当該無線端末宛てのパケット転送は所要の品質を維持し得る中継転送方法により行われることとなる。

【０１６０】以上、本実施形態の特徴的な動作例を説明したが、他の動作については既に説明した上記第１の実施形態の動作と同様である。すなわち、本実施形態における無線端末のパケットの送信動作のフローは既に図５を参照して説明したものと同じである。既に説明したよ

うに図５に示されるパケット送信の動作では、請求項５に係る判定方法により「登録抹消条件」に関する判定が行われる。従って、本実施形態では、無線端末の受信動作（図１３）においては請求項８に係る判定方法に従って「登録抹消条件」に関する判定が行われ、無線端末の送信動作では請求項５に係る判定方法に従って「登録抹消条件」に関する判定が行われることとなる。なお、このように請求項８に係る判定方法と請求項５に係る判定方法を併用するのでなく、請求項８に係る判定方法のみを使用し、請求項５に係る判定方法による判定を省略してもよい。

【０１６１】また、本実施形態における無線基地局のパケット中継の動作フローは既に図６を参照して説明したものと同じである。また、無線端末が直接転送テーブルに登録された無線端末宛てにパケットを送信する場合の動作シーケンス例は、前掲図７に示したものと同じであり、無線端末が他の無線端末を直接転送テーブルに登録する場合の動作シーケンス例は前掲図８に示したものと同じである。さらに無線端末が直接転送テーブルに登録されていない無線端末宛てにパケットを送信する場合の動作シーケンス例は、前掲図９に示したものと同じである。また、例えば無線端末Ａの直接転送テーブルに無線端末Ｂが登録されており、かつ、無線端末Ｂが無線端末Ａから送信されたパケットを受信できない場合の動作シーケンスは、前掲図１０に示したものと同じである。また、前掲図１１に例示するように、データパケットの授受を行う無線端末Ａと無線端末Ｂが隣接する２つの無線基地局に各々収容されている場合においても、上記と同様な直接転送テーブルの登録および登録抹消を行い、直接転送方法または中継転送方法によるパケット転送を行うことができる。また、無線端末と有線端末がパケット転送を行う場合の動作シーケンスは前掲図１２に示したものと同様である。

【０１６２】以上、「登録条件」に関する判定を請求項２に係る判定方法により行い、「登録抹消条件」に関する判定を請求項５に係る判定方法および請求項８に係る判定方法を併用して行う場合を例に本実施形態の説明を行ったが、請求項２に係る判定方法の代りに請求項３または４に係る判定方法を使用し、あるいは請求項５に係る判定方法の代りに請求項６または７に係る判定方法を使用し、あるいは請求項８に係る判定方法の代りに請求項９または１０に係る判定方法を使用してもよい。また、上述したように、請求項５に係る判定方法による判定を省略してもよい。

【０１６３】Ｄ．第３の実施形態

本実施形態において、無線端末と無線端末との間および無線端末と無線基地局との間で授受される無線パケットのフォーマットは、上記各実施形態と同様、前掲図２に示した通りである。また、上記各実施形態と同様、各無線端末は、前掲図４に例示する直接転送テーブルを記憶し、この直接転送テーブルの登録内容に従って、直接転送方法または中継転送方法の選択を行う。また、本実施形態では、直接転送テーブルに登録される各無線端末毎に監視タイマが用意される。なお、これらの監視タイマの使用方法については本実施形態の動作説明において明らかにする。

【０１６４】本実施形態において、無線端末が、任意の無線端末のＭＡＣアドレスを直接転送テーブルに登録するための登録条件は、既に上記各実施形態において説明したものと同様である。

【０１６５】一方、直接転送テーブルから無線端末のＭＡＣアドレスを削除するための登録抹消条件に関しては、本実施形態では以下のいずれかを満たすことを要求するようにしている。

【０１６６】登録抹消条件① ：自局から当該無線端末に対し直接転送方法によりパケットの転送を行い、パケット送信不完了になるという事態が所定の限度を越えた頻度で発生したこと（請求項５～７に相当）。

【０１６７】登録抹消条件② ：当該無線端末によって送信されたパケットを自局が所定の閾値未満の受信レベルで受信するという事態が所定の限度を越えた頻度で発生したこと（請求項８～１０に相当）。

【０１６８】登録抹消条件③ ：一定期間、当該無線端末が送信したパケットを自局が所定の閾値以上の受信レベルで受信するという事態が１回も生じず、かつ、自局から当該無線端末に対してパケットの転送を行い、パケット送信完了となるという事態が１回も生じないこと（請求項１１に相当）。

【０１６９】上記のうち登録抹消条件① および② は、上記第２の実施形態でも採用している。本実施形態は、これらに加え、上記登録抹消条件③ を採用したものである。

【０１７０】図１５および図１６は、本実施形態における無線端末のデータパケットの受信動作を示すフローチャートである。この受信動作のフローは、上記第２の実施形態における無線端末のデータパケットの受信動作のフロー（前掲図１３）と大体において同じである。ただし、上記登録抹消条件③ を新たに加えた関係上、前掲図１３におけるステップＳ４０５およびＳ４０８が本実施形態ではステップＳ４０５ＡおよびＳ４０８Ａに置き換えられており、さらに本実施形態では新たなステップＳ４２１Ａ～Ｓ４２３Ａが追加されている。他のステップについては、前掲図１３のものと変りはない。これらについては、ステップの番号として前掲図１３において使用したものと共通のものを使用している。

【０１７１】図１５および図１６のフローに従って、無線端末のデータパケットの受信動作の要点を説明すると、次のようになる。

【０１７２】無線端末は、転送種別が“００”または“０１”であり、かつ、受信レベルが閾値Ｌ１以上のデ

ータパケットを受信したとき、当該データパケットの送信元無線端末のアドレスを直接転送テーブルに登録し、当該送信元無線端末に対応した監視タイマをスタートする（ステップＳ４０１、Ｓ４０２、Ｓ４０３、Ｓ４０４、Ｓ４０５Ａ）。ただし、当該データパケットの送信元無線端末のアドレスが直接転送テーブルに既に登録されている場合には、監視タイマをリスタートする処理のみを行う（ステップＳ４０１、Ｓ４０２、Ｓ４０３、Ｓ４０４、Ｓ４２１Ａ）。

【０１７３】また、無線端末は、転送種別が“００”または“０１”であり、かつ、受信レベルが閾値Ｌ２未満のデータパケットを受信したとき、直接転送テーブルにおける当該データパケットの送信元無線端末のアドレスの登録を抹消し、当該送信元無線端末に対応した監視タイマを停止させる（ステップＳ４０１、Ｓ４０２、Ｓ４０３、Ｓ４０６、Ｓ４０７、Ｓ４０８Ａ）。

【０１７４】また、無線端末は、転送種別が“００”または“０１”であり、かつ、受信レベルが閾値Ｌ２以上のデータパケットを受信したとき、当該データパケットの送信元無線端末のアドレスが直接転送テーブルに既に登録されている場合には、監視タイマをリスタートする（ステップＳ４０１、Ｓ４０２、Ｓ４０３、Ｓ４０６、Ｓ４２２Ａ、Ｓ４２３Ａ）。

【０１７５】以上が無線端末によるデータパケットの受信に伴って行われる直接転送テーブル関連の処理および監視タイマ関連の処理の内容である。これらの処理を終えた後、無線端末は、データパケットが自局に宛てた転送種別“００”または“１０”のデータパケットであるか否かを判断し（ステップＳ４０９、Ｓ４１０）、この判断結果が肯定的である場合にＡＣＫ信号の送信およびデータパケットの上位レイヤへの引き渡しを行う（ステップＳ４１２）。このステップＳ４０９以降の処理については上記第２の実施形態と何等変るところがない。

【０１７６】次に、図１７は、本実施形態における無線端末のデータパケットの送信動作を示すフローチャートである。この送信動作のフローは、上記第１の実施形態における無線端末のデータパケットの送信動作のフロー（前掲図５）と大体において同じである。ただし、上記登録抹消条件㉙を新たに加えた関係上、前掲図５におけるステップＳ２０９が本実施形態ではステップＳ２０９Ａに置き換えられており、さらに本実施形態では新たなステップＳ２２１Ａが追加されている。他のステップについては、前掲図５のものと変りはない。これらについては、ステップの番号として前掲図５において使用したものと共通のものを使用している。

【０１７７】図１７のフローに従って、無線端末のデータパケットの送信動作の要点を説明すると、次のようになる。

【０１７８】無線端末は、転送種別が“００”（直接転送）であるデータパケットの送信後、ＡＣＫ信号を受信したときは、宛先無線端末に対応した監視タイマをリスタートする（ステップＳ２０１、Ｓ２０２、Ｓ２０３、Ｓ２０４、Ｓ２０５、Ｓ２２１Ａ）。

【０１７９】しかし、転送種別が“００”（直接転送）であるデータパケットを無線端末が送信した後、無線端末がｍ２回連続してＡＣＫ信号を受信しないたときは、直接転送テーブルにおける当該宛先無線端末のアドレスの登録を抹消するとともに、当該宛先無線端末に対応した監視タイマを停止させる（ステップＳ２０５、Ｓ２０６、Ｓ２０９Ａ）。

【０１８０】この場合、当該データパケットの再送は、中継転送方法により行う（ステップＳ２１０～Ｓ２１６）。なお、この中継転送方法については既に第１の実施形態において説明したものと同じであるので、ここでは説明を省略する。

【０１８１】さて、既に説明したように、本実施形態における無線端末は、直接転送テーブルにアドレスを登録した各無線端末について監視タイマによる計時を行う（図１５のステップＳ４０５Ａ）。そして、いずれかの監視タイマがタイムオーバーになると、本実施形態に係る無線端末は、図１８に示す監視タイマオーバールーチンが実行し、タイムオーバーとなった監視タイマに対応した無線端末のアドレスを直接転送テーブルから削除する。

【０１８２】ここで、計時を開始した監視タイマは、当該監視タイマに対応した無線端末から閾値Ｌ１以上の受信レベルでデータパケットを受信した場合（図１５のステップＳ４２１Ａ）、当該監視タイマに対応した無線端末から閾値Ｌ２以上の受信レベルでデータパケットを受信し、かつ、当該無線端末が直接転送テーブルに登録されている場合（図１５のステップＳ４２３Ａ）または当該監視タイマに対応した無線端末に直接転送方法によりデータパケットを送信し、ＡＣＫ信号を受信した場合（図１７のステップＳ２２１Ａ）にリスタートする。

【０１８３】従って、一定時間（監視タイマのタイマ設定時間）に亙って、当該監視タイマに対応した無線端末から閾値Ｌ１またはＬ２以上の受信レベルでデータパケットを１回も受信することがなく、かつ、当該監視タイマに対応した無線端末に対し直接転送方法によりデータパケットを送信し、それが成功に終わるという事態が１回も生じない場合に（上述した登録抹消条件㉙）、当該監視タイマがタイムオーバーとなり、当該監視タイマに対応した無線端末の直接転送テーブルへの登録が解除されるのである。

【０１８４】次に図１９～図２２の各動作シーケンス図を参照し、本実施形態の各種の動作例をさらに具体的に説明する。

【０１８５】まず、図１９は、無線端末が直接転送テーブルに登録された無線端末宛てに直接転送方法によりデータパケットを転送する場合の動作シーケンスを示して

いる。

【０１８６】図１９において、無線端末Ｂの直接転送テーブルには、無線端末Ａが登録されている。このため、無線端末Ｂにおいて、無線端末Ａ宛てに転送すべきデータパケットが生じると、無線端末Ｂは直接転送方法を選択し、宛先アドレスを無線端末ＡのＭＡＣアドレスとし、転送種別を“００”として、当該データパケットを送信する。

【０１８７】無線端末Ａは、このデータパケットを受信すると、受信レベルを判定し、受信レベルが閾値Ｌ１以上である場合は送信元無線端末ＢのＭＡＣアドレスを直接転送テーブルに登録し、無線端末Ｂに対応した監視タイマをスタートする。

【０１８８】また、無線端末Ａは、受信したデータパケットの転送種別が“００”であり、かつ、その宛先アドレスが自局のＭＡＣアドレスと一致していることから、ＡＣＫ信号を送信元無線端末Ｂ宛てに送信し、当該データパケットを上位レイヤに引き渡す。

【０１８９】無線端末Ｂは、このＡＣＫ信号を受信すると、無線端末Ａ宛ての直接転送方法によるデータパケット送信が成功したことを認識し、無線端末Ａに対応した監視タイマをリスタートする。

【０１９０】次に図２０は、無線端末が他の無線端末宛てに送信されたデータパケットを受信するのに伴い、そのデータパケットの送信元無線端末を直接転送テーブルに登録する場合の動作シーケンスを示している。

【０１９１】図２０において、無線端末Ａの直接転送テーブルには、無線端末Ｃが登録されている。このため、無線端末Ａにおいて、無線端末Ｃ宛てに転送すべきデータパケットが生じると、無線端末Ａは直接転送方法を選択し、宛先アドレスを無線端末ＣのＭＡＣアドレスとし、転送種別を“００”として、当該データパケットを送信する。

【０１９２】無線端末Ｃは、このデータパケットを受信すると、ＡＣＫ信号を送信元無線端末Ａに送信する。無線端末Ａは、このＡＣＫ信号を受信することにより、無線端末Ｃに対する直接転送方法によるデータパケット送信が成功に終わったことを認識する。

【０１９３】ところで、上記無線端末Ｃ宛てのデータパケットが、第三者たる無線端末Ｂによって受信される場合がある。

【０１９４】この場合、無線端末Ｂは、受信レベルが閾値Ｌ１以上であるか否かを判断する。そして、受信レベルが閾値Ｌ１以上である場合には、当該データパケットの送信元無線端末ＡのＭＡＣアドレスを直接転送テーブルに登録し、かつ、無線端末Ａに対応した監視タイマをスタートする。また、受信したデータパケットは、無線端末Ｃ宛てのものであるため、廃棄する。

【０１９５】次に図２１は、無線端末が直接転送方法により転送されたデータパケットを受信し、その際の受信レベルが閾値未満であることから、無線端末が当該データパケットの送信元無線端末の直接転送テーブルにおける登録を抹消する動作シーケンスを示している。

【０１９６】図２１において、無線端末Ａの直接転送テーブルには無線端末ＢのＭＡＣアドレスが登録されており、無線端末Ｂの直接転送テーブルには無線端末ＡのＭＡＣアドレスが登録されている。このため、無線端末Ａにおいて、無線端末Ｂ宛てに転送すべきデータパケットが生じると、無線端末Ａは直接転送方法を選択し、宛先アドレスを無線端末ＢのＭＡＣアドレスとし、転送種別を“００”として、当該データパケットを送信する。

【０１９７】無線端末Ｂは、このデータパケットを受信すると、受信レベルを判定し、受信レベルが閾値Ｌ２未満である場合は送信元無線端末ＡのＭＡＣアドレスを直接転送テーブルから削除し、無線端末Ａに対応した監視タイマを停止する。

【０１９８】また、無線端末Ｂは、受信したデータパケットの転送種別が“００”であり、かつ、その宛先アドレスが自局のＭＡＣアドレスと一致していることから、ＡＣＫ信号を送信元無線端末Ａ宛てに送信し、当該データパケットを上位レイヤに引き渡す。

【０１９９】無線端末Ａは、このＡＣＫ信号を受信すると、無線端末Ｂ宛ての直接転送方法によるデータパケット送信が成功したことを認識し、無線端末Ｂに対応した監視タイマをリスタートする。

【０２００】次に図２２は、無線端末において、ある無線端末に対応した監視タイマがタイムオーバーとなった場合の動作シーケンスを例示している。

【０２０１】図２２において、無線端末Ａの直接転送テーブルには無線端末ＢのＭＡＣアドレスが登録されている。従って、無線端末Ａでは、無線端末Ｂに対応した監視タイマによる計時が行わる。そして、図２２に示す例では、無線端末Ｂから直接転送方法により無線端末Ａ宛てのデータパケットが３回送信されるが、いずれも失敗に終わる。このため、無線端末Ａでは、無線端末Ｂに対応した監視タイマがタイムオーバーとなり、無線端末Ａは、直接転送テーブルにおける無線端末Ｂの登録を抹消する。

【０２０２】その後、無線端末Ａにおいて無線端末Ｂ宛てに転送すべきデータパケットが発生する。しかし、このとき無線端末Ａの直接転送テーブルには無線端末Ｂが登録されていないため、無線端末Ａは中継転送方法により無線端末Ｂ宛てのデータパケットの転送を行うのである。

【０２０３】以上説明したように、本実施形態においては、無線端末を直接転送テーブルに登録したとしても、その後、一定時間以上、当該無線端末から送信されたデータパケットが受信されず、かつ、当該無線端末宛ての直接転送が成功するという事態も生じない場合には、当該無線端末の移動等の原因により直接転送方法の適用が

困難な状況に陥ったとみなし、直接転送テーブルにおける当該無線端末の登録を抹消し、以後は中継転送方法により当該無線端末宛てのデータパケットの転送を行うのである。

【０２０４】以上、本実施形態の特徴的な動作例を説明したが、他の動作については既に説明した上記第１および第２の実施形態の動作と同様である。

【０２０５】Ｅ．第４の実施形態

本実施形態は、パワーセーブモードとアクティブモードの２種類のモードを有する無線端末からなる無線パケット転送システムに本発明を適用した実施形態であり、請求項１２に係る発明の実施形態である。

【０２０６】図２３は本実施形態における無線端末と無線端末との間および無線端末と無線基地局との間で授受される無線パケットフォーマットを示すものであり、図２３（ａ）がデータパケットのフォーマット、図２３（ｂ）がＡＣＫ信号のフォーマットである。

【０２０７】図２３（ａ）に示すように、本実施形態におけるデータパケットは、パワーセーブモードフラグを含んでいる。無線端末は、パワーセーブモードに遷移するとき、このパワーモードフラグを“１”に設定してデータパケットを送信し、アクティブモードに遷移するとき、このパワーモードフラグを“０”に設定してデータパケットを送信する。

【０２０８】また、無線端末は、予め無線基地局に対し、パワーセーブモードでの動作中における受信機の起動と停止の周期を通知する。無線基地局は、パワーセーブモードで動作している無線端末宛てのデータパケットを受信した場合には、当該データパケットをバッファリングし、当該宛先無線端末の受信機が起動しているタイミングで当該データパケットの送信を行う。

【０２０９】本実施形態においても、無線端末から他の無線端末に対し、直接転送方法によるデータパケットの転送を行うことができるが、パワーセーブモードで動作している無線端末宛てに直接転送方法によるデータパケットの送信を行うと、受信機の停止しているタイミングで送信が行われ、送信不完了となる可能性が高い。そこで、本実施形態では、各無線端末が、図２４に示すように、直接転送方法を適用できる無線端末のＭＡＣアドレスの他、当該無線端末がパワーセーブモードで動作中か否かのパワーセーブモードフラグをも直接転送テーブルに登録するようにしている。

【０２１０】図２５および図２６は、本実施形態における無線端末のデータパケットの受信動作を示すフローチャートである。この受信動作のフローは、上記第２の実施形態における無線端末のデータパケットの受信動作のフロー（前掲図１３）と大体において同じである。ただし、各無線端末がアクティブモードのみならずパワーセーブモードでも動作する関係上、前掲図１３のフローに対し、新たなステップＳ４３１ＢおよびＳ４３２Ｂが追加されている。他のステップについては、前掲図１３のものと変りはない。これらについては、ステップの番号として前掲図１３において使用したものと共通のものを使用している。

【０２１１】図２５および図２６のフローに従って、無線端末のデータパケットの受信動作の要点を説明すると、次のようになる。

【０２１２】無線端末は、転送種別が“００”または“０１”であり、かつ、受信レベルが閾値Ｌ１以上のデータパケットを受信したとき、当該データパケットの送信元無線端末のアドレスを直接転送テーブルに登録する（ステップＳ４０１、Ｓ４０２、Ｓ４０３、Ｓ４０４、Ｓ４０５）。

【０２１３】また、無線端末は、転送種別が“００”または“０１”であり、かつ、受信レベルが閾値Ｌ２未満のデータパケットを受信したとき、直接転送テーブルにおける当該データパケットの送信元無線端末のアドレスの登録を抹消する（ステップＳ４０１、Ｓ４０２、Ｓ４０３、Ｓ４０６、Ｓ４０７、Ｓ４０８）。

【０２１４】また、無線端末は、転送種別が“００”または“０１”であるデータパケットを受信したときは、当該データパケットの送信元無線端末のアドレスが直接転送テーブルに登録されているか否かを判断する（ステップＳ４３１Ｂ）。そして、送信元無線端末のアドレスが登録されている場合には、当該データパケット中のパワーセーブモードフラグにより、直接転送テーブルに登録された当該送信元無線端末に対応したパワーモードセーブフラグを更新する。このような動作が各無線端末において行われるため、ある無線端末がデータパケットの送信を行った場合には、当該無線端末がパワーセーブモードで動作中か否かの情報が当該データパケットを受信した各無線端末に周知され、各無線端末の直接転送テーブルに登録されることとなるのである。

【０２１５】以上が無線端末によるデータパケットの受信に伴って行われる直接転送テーブル関連の処理の内容である。これらの処理を終えた後、無線端末は、データパケットが自局に宛てた転送種別“００”または“１０”のデータパケットであるか否かを判断し（ステップＳ４０９、Ｓ４１０）、この判断結果が肯定的である場合にＡＣＫ信号の送信およびデータパケットの上位レイヤへの引き渡しを行う（ステップＳ４１２）。このステップＳ４０９以降の処理については上記第２の実施形態と何等変るところがない。

【０２１６】次に図２７は、本実施形態における無線端末のデータパケットの送信動作を示すフローチャートである。この送信動作のフローは、上記第１の実施形態における無線端末のデータパケットの送信動作のフロー（前掲図５）と大体において同じである。ただし、各無線端末がアクティブモードのみならずパワーセーブモードでも動作する関係上、前掲図５のフローに対し、新た

なステップＳ２３１Ｂが追加されている。他のステップについては、前掲図５のものと変りはない。これらについては、ステップの番号として前掲図５において使用したものと共通のものを使用している。

【０２１７】本実施形態における無線端末のデータパケットの送信動作を図２７のフローに従って説明すると次の通りである。すなわち、無線端末は、他の無線端末に転送すべきデータパケットが生じた場合、当該データパケットの宛先無線端末に対応したアドレスが直接転送テーブルに登録されているか否かを判断する（ステップＳ２０２）。そして、宛先無線端末に対応したアドレスが直接転送テーブルに登録されている場合には、その宛先無線端末に対応したパワーセーブモードフラグの内容を直接転送テーブルから読み出し、当該パワーセーブモードフラグが“０”か否かを判断する。そして、パワーセーブモードフラグが“０”、すなわち、宛先無線端末がアクティブモードで動作している場合には、直接転送方法による当該データパケットの転送を試み（ステップＳ２０３～Ｓ２０９）、これに失敗した場合に中継転送方法による転送を実行する（ステップＳ２１０～Ｓ２１６）。これに対し、パワーセーブモードフラグが“１”、すなわち、宛先無線端末がパワーセーブモードで動作している場合には、直接転送方法による転送を全く試みることなく、中継転送方法による転送を実行する（ステップＳ２１０～Ｓ２１６）。なお、直接転送方法による転送（ステップＳ２０３～Ｓ２０９）および中継転送方法による転送（ステップＳ２１０～Ｓ２１６）については、既に第１の実施形態において説明したものと同じであるので、ここでの説明は省略する。

【０２１８】本実施形態において無線基地局がデータパケットの中継を行う場合の動作は、上記第１の実施形態の場合（前掲図６参照）と同様であるので説明を省略する。

【０２１９】次に図２８および図２９は、本実施形態の一動作例を示す動作シーケンス図です。この動作例において、無線端末Ａは、アクティブモードからパワーセーブモードに遷移する際、それに先立ち、データパケットの送信を行っている。このデータパケットは、送信元無線端末Ａがパワーセーブモードに遷移しようとしているため、パワーセーブモードフラグが“１”となっており、また、転送種別が“０１”となっている。無線基地局は、このデータパケットを受け取った場合、ＡＣＫ信号を無線端末Ａ宛てに送信し、無線端末ＡはこのＡＣＫ信号の受信によりデータパケットの送信成功を認識する。

【０２２０】また、この動作例では、無線端末Ａから送信された上記データパケットを無線端末Ｂが受信している。ここで、無線端末Ｂの直接転送テーブルには、無線端末Ａのアドレスが登録されている。無線端末Ｂは、当該データパケットの受信レベルが閾値Ｌ２以上である場合に、直接転送テーブルにおける当該データパケットの送信元無線端末Ａに対応したパワーセーブモードフラグを当該データパケットに含まれるパワーセーブモードフラグ（＝“１”）によって更新する。また、当該データパケットは、無線端末Ｂ宛てのものでないため廃棄する。

【０２２１】その後、無線端末Ｂにおいて、無線端末Ａ宛てに転送すべきデータパケットが発生する。この動作例では、無線端末Ｂの直接転送テーブルに宛先無線端末ＡのＭＡＣアドレスが登録されているため、無線端末Ｂは、直接転送テーブルに登録された宛先無線端末Ａに対応したパワーモードセーブフラグが“１”か否かを判断する。この場合、当該パワーモードフラグは“１”となっているため、無線端末Ｂは、宛先アドレスを無線端末ＡのＭＡＣアドレスとし、転送種別を“０１”としてデータパケットを送信する。無線基地局は、このデータパケットを受信すると、送信元無線端末Ｂ宛てにＡＣＫ信号を送信する。無線端末Ｂは、このＡＣＫ信号の受信により、データパケットの送信が成功したことを認識する。

【０２２２】ここで、無線基地局は、無線端末Ａがパワーセーブモードで動作していることを認識しており、また、パワーセーブモードで動作している無線端末Ａの受信機の起動および停止の周期を把握している。そこで、無線基地局は、上記無線端末Ｂから受信した無線端末Ａ宛てのデータパケットをバッファリングし、無線端末Ａの受信機が起動中であるタイミングで当該データパケットを送信する。無線端末Ａは、このデータパケットを受信すると、上位レイヤに引き渡す。

【０２２３】Ｆ．第５の実施形態

本実施形態は、請求項１３に係る発明の実施形態である。本実施形態において無線端末と無線端末との間および無線端末と無線基地局との間で授受される無線パケットのフォーマットは前掲図２３に示した通りである。また、無線端末のデータパケットの受信動作は上記第４の実施形態（図２５および図２６）と同様である。

【０２２４】本実施形態において無線端末が行うデータパケットの送信動作のフローを図３０および図３１に示す。この送信動作のフローは、上記第４の実施形態における送信動作のフロー（図２７）に対し、新たなステップＳ２４１Ｃ～Ｓ２４７Ｃが加わっている。他のステップについては、上記第４の実施形態におけるものと変るとことがない。そのようなステップについては、図２７において用いたものと同じステップ番号を使用している。

【０２２５】送信元無線端末が他の無線端末宛てにデータパケットを転送しようとする場合において、当該宛先無線端末が直接転送テーブルに登録されており、かつ、当該宛先無線端末のパワーセーブモードフラグが“０”（すなわち、アクティブモード）である場合には、送信

元無線端末は、まず、直接転送方法を選択する（ステップＳ２０１、Ｓ２０２、Ｓ２３１Ｂ、Ｓ２０３）。

【０２２６】次に、送信元無線端末は、宛先無線端末が認証成功テーブルに登録されているか否かを判断する（ステップＳ２４１Ｃ）。ここで、認証成功テーブルには、過去、認証に成功した無線端末のアドレスが登録されている。なお、認証成功テーブルに対して無線端末のアドレスの登録を行う動作については後述する。

【０２２７】上記ステップＳ２４１Ｃの判断結果が「ＹＥＳ」である場合、送信元無線端末は、直ちに宛先無線端末に対し、直接転送方法によるデータパケットの転送を行う（ステップＳ２０４～Ｓ２０９）。

【０２２８】これに対し、ステップＳ２４１Ｃの判断結果が「ＮＯ」である場合、無線端末は、宛先無線端末が認証拒否テーブルに登録されているか否かを判断する（ステップＳ２４２Ｃ）。ここで、認証拒否テーブルには、過去、認証が拒否された無線端末のアドレスが登録されている。なお、認証拒否テーブルに対して無線端末のアドレスの登録を行う動作については後述する。

【０２２９】上記ステップＳ２４２Ｃの判断結果が「ＹＥＳ」である場合、無線端末は、中継転送方法によるデータパケットの送信のための処理を実行する（ステップＳ２１０～Ｓ２１６）。

【０２３０】一方、上記ステップＳ２４２Ｃの判断結果が「ＮＯ」である場合、無線端末は、宛先無線端末に対し認証要求を送信する（ステップＳ２４３Ｃ）。そして、この認証が成功したか否かを判断し（ステップＳ２４４Ｃ）、認証に成功した場合には宛先無線端末のアドレスを認証成功テーブルに登録し（ステップＳ２０４）、直接転送方法によるデータパケットの送信のための処理を実行する（ステップＳ２０４～Ｓ２０９）。これに対し、認証に成功しなかった場合には、認証が拒否されたか否かを判断する（ステップＳ２４６Ｃ）。そして、認証が拒否されたのではない場合には無線端末は、中継転送方法によるデータパケットの送信のための処理を実行する（ステップＳ２１０～Ｓ２１６）。また、認証が拒否された場合には、宛先無線端末のアドレスを認証拒否テーブルに登録してから（ステップＳ２４７Ｃ）、中継転送方法によるデータパケットの送信のための処理を実行する（ステップＳ２１０～Ｓ２１６）。

【０２３１】本実施形態によれば、認証に成功しない場合には中継転送方法によりパケット転送が行われるため、未認証の宛先無線端末に直接転送を行ったパケットが宛先無線端末側で廃棄されるという事態を回避することができる。また、本実施形態によれば、過去、認証が成功した無線端末に対しては、認証を省略して直接転送方法によるデータパケット転送を行うことができ、過去、認証が拒否された無線端末に対しては、無駄な認証のための手続を行うことなく、中継転送方法によるデータパケットの転送を行うことができるという利点がある。

【０２３２】図３２および図３３は、各々本実施形態の動作例を示す動作シーケンス図である。以下、これらの図を参照し、本実施形態の動作をさらに具体的に説明する。

【０２３３】まず、図３２に示す動作例において、無線端末Ａの直接転送テーブルには、宛先無線端末ＢのＭＡＣアドレスが登録されており、また、無線端末Ａと無線端末Ｂとの間では認証が行われたことがなく、認証が拒否されたこともない。

【０２３４】このため、無線端末Ａにおいて無線端末Ｂ宛てに転送すべきデータパケットが生じると、無線端末Ａは無線端末Ｂに対し、認証要求を送る。無線端末Ｂは認証をする場合には、認証を許可する旨の認証結果通知を無線端末Ａに送り、無線端末Ａのアドレスを認証許可テーブルに登録する。

【０２３５】無線端末Ａは、上記認証結果通知を受信すると、認証許可テーブルに無線端末Ｂのアドレスを登録する。

【０２３６】その後、無線端末Ａにおいて無線端末Ｂ宛てに転送すべきデータパケットが生じたときには、無線端末Ａは認証を省略し、無線端末Ｂ宛てに直接転送方法によるデータパケットの転送を行う。

【０２３７】無線端末Ｂは、このデータパケットを受信すると、その送信元無線端末Ａが認証許可テーブルに登録された無線端末か否かを判断し、判断結果が「ＹＥＳ」である場合には当該無線端末Ａ宛てにＡＣＫ信号を送信し、当該データパケットを上位レイヤに引き渡す。

【０２３８】無線端末Ａは、無線端末ＢからのＡＣＫ信号を受信することにより、データパケットの送信が成功したことを認識する。

【０２３９】次に図３３に示す動作例について説明する。この動作例においても、無線端末Ａの直接転送テーブルには、宛先無線端末ＢのＭＡＣアドレスが登録されており、また、無線端末Ａと無線端末Ｂとの間では認証が行われたことがなく、認証が拒否されたこともない。

【０２４０】このため、無線端末Ａにおいて無線端末Ｂ宛てに転送すべきデータパケットが生じると、無線端末Ａは無線端末Ｂに対し、認証要求を送る。ところが、この動作例における無線端末Ｂは、認証を拒否する旨の認証結果通知を無線端末Ａに送る。

【０２４１】無線端末Ａは、上記認証結果通知を受信すると、認証拒否テーブルに無線端末Ｂのアドレスを登録する。

【０２４２】その後、無線端末Ａにおいて無線端末Ｂ宛てに転送すべきデータパケットが生じたときには、無線端末Ａは認証を行うことなく、無線端末Ｂ宛てに中継転送方法によるデータパケットの転送を行う。

【０２４３】すなわち、無線端末Ａは、宛先アドレスを無線端末ＢのＭＡＣアドレスとし、転送種別を“０１”

としてデータパケットを送信する。無線基地局は、このデータパケットを受信すると、送信元無線端末Ａ宛てにＡＣＫ信号を送信する。無線端末Ａは、このＡＣＫ信号を受信することにより、データパケットの送信成功を認識する。また、無線基地局は、転送種別を“１０”として、無線端末Ａからの上記データパケットを送信する。無線端末Ｂは、このデータパケットを受信すると、上位レイヤに引き渡す。

【０２４４】以上が本実施形態における特徴的な動作例である。なお、本実施形態において無線端末は、直接転送テーブルに登録された無線端末の登録を抹消するときに、認証成功テーブルまたは認証拒否テーブルにおける当該無線端末の登録抹消を行わない。従って、例えば無線端末間の障害物が頻繁に移動して直接転送テーブルの登録および登録抹消が頻繁に生じるような場合でも、これによって認証成功テーブルまたは認証拒否テーブルの登録状態が変化することはない。このため、ある無線端末について直接転送テーブルにおける登録抹消が行われた後、再び当該無線端末について直接転送テーブルへの登録が行われたような場合に、過去、認証が成功しているのであれば、重ねて認証を行うことなく、当該無線端末に直接転送を行うことができる。なお、認証成功テーブルまたは認証拒否テーブルに対し、膨大な数の無線端末が登録されることが予想される場合にはその対処が必要になる。この場合、例えば認証成功テーブル等の登録された無線端末の総数が例えば最大登録数を越えそうなときに、最も古いものの登録を抹消するようにしてもよい。

【０２４５】Ｇ．第６の実施形態

無線パケット転送システムでは、無線端末から他の全ての無線端末に対して同一内容をデータパケットを一斉に転送するブロードキャストが行われる場合がある。本実施形態は、このようなブロードキャストが行われる無線パケット転送システムに本発明を適用したものであり、請求項１４に係る発明の実施形態である。本実施形態において無線端末と無線基地局との間で授受される無線パケットのフォーマットは前掲図２３に示した通りである。

【０２４６】本実施形態において無線端末が行うデータパケットの受信動作のフローを図３４および図３５に示す。この送信動作のフローは、上記第４の実施形態における送信動作のフロー（図２５および図２６）に対し、新たなステップＳ４５１Ｄが加わったものとなっている。他のステップについては、上記第４の実施形態におけるものと変るとことがない。そのようなステップについては、図２５および図２６において用いたものと同じステップ番号を使用している。

【０２４７】本実施形態において無線端末は、ステップＳ４０９において、受信したデータパケットの宛先アドレスが自局のアドレスと一致しているかを判断するが、この判断結果が「ＮＯ」である場合、当該データパケットがブロードキャストパケットであるか否かを判断する（ステップＳ４５１Ｄ）。そして、当該データパケットがブロードキャストパケットである場合には当該データパケットを上位レイヤに引き渡し（ステップＳ４１２）、ブロードキャストパケットでない場合には当該データパケットを廃棄する（ステップＳ４１３）。他の動作については、上記第４の実施形態と何等変るところがない。

【０２４８】次に、本実施形態において無線端末が行うデータパケットの送信動作のフローを図３６および図３７に示す。この送信動作のフローは、上記第５の実施形態における送信動作のフロー（図３０および図３１）に対し、新たなステップＳ２５１Ｄが加わったものとなっている。他のステップについては、上記第５の実施形態におけるものと変るところがない。そのようなステップについては、図３０および図３１において用いたものと同じステップ番号を使用している。

【０２４９】本実施形態において無線端末は、データパケットの転送をしようとする場合、その転送をブロードキャストとして行うか否かを判断する（ステップＳ２５１Ｄ）。そして、この判断結果が「ＮＯ」である場合には、ステップＳ２０１に進み、以後、上記第５の実施形態と全く同様な処理を実行する。これに対し、ステップＳ２５１Ｄの判断結果が「ＹＥＳ」である場合には、中継転送方法により当該データパケットのブロードキャストを実行する（ステップＳ２１０～Ｓ２１６）。

【０２５０】図３８は本実施形態の具体的動作例を示した動作シーケンス図である。この図３８に示すように、無線端末Ａは、ブロードキャストによりデータパケットの転送をする場合には、転送種別を“０１”とし、宛先アドレスをブロードキャストに対応した情報とし、当該データパケットを送信する。無線基地局は、このデータパケットを受信すると、ＡＣＫ信号を送り返すとともに、転送種別を“１０”として当該データパケットを送信する。当該無線基地局に収容される全ての無線端末は、このデータパケットを受信すると、当該データパケットがブロードキャストパケットであることを認識し、上位レイヤに引き渡す。

【０２５１】Ｈ．第７の実施形態

本実施形態は、無線端末が無線基地局のサービス圏外にある場合に直接転送方法により所望の無線端末にデータパケット転送を行い得るようにしたものであり、請求項１５に係る発明の実施形態である。本実施形態は、既に説明した各実施形態のいずれに適用することも可能であるが、以下では上記第６の実施形態に適用した場合を例に説明する。

【０２５２】本実施形態において、無線基地局は、報知信号を周期的に送信する。無線端末は、この報知信号を正しく受信した場合には自局が当該無線基地局のサービ

ス圏内に在圏していると判断し、正しく受信しなかった場合には自局が当該無線基地局のサービス圏外にあると判断する。

【０２５３】本実施形態において無線端末が行うデータパケットの送信動作の動作フローを図３９および図４０に示す。この送信動作のフローは、上記第６の実施形態における送信動作のフロー（図３６および図３７）に対し、新たなステップＳ２６１Ｅが加わったものとなっている。他のステップについては、上記第６の実施形態におけるものと変るところがない。そのようなステップについては、図３６および図３７において用いたものと同じステップ番号を使用している。

【０２５４】本実施形態において無線端末は、データパケットの転送をしようとする場合、自局が無線基地局のサービス圏内に在圏しているか否かを判断する（ステップＳ２６１Ｅ）。

【０２５５】そして、自局がサービス圏外にある場合（ステップＳ２６１Ｅの判断結果が「ＮＯ」である場合）または自局がサービス圏内にあり、かつ、宛先無線端末が直接転送テーブルに登録されている場合（ステップＳ２６１ＥおよびステップＳ２０２の判断結果が「ＹＥＳ」である場合）には、直接転送方法による宛先無線端末へのデータパケット転送を試みる（ステップＳ２０３～Ｓ２０）。

【０２５６】一方、自局がサービス圏内にあり、かつ、宛先無線端末が直接転送テーブルに登録されていない場合（ステップＳ２６１Ｅの判断結果が「ＹＥＳ」であり、かつ、ステップＳ２０２の判断結果が「ＮＯ」である場合）には、中継転送方法による宛先無線端末へのデータパケット転送を実行する（ステップＳ２１０～Ｓ２１６）。他の点については、上記第６の実施形態と同様である。

【０２５７】Ｉ．第８の実施形態

本実施形態は、無線端末が無線基地局の切り替え（ハンドオフ）を行う場合の便宜を図ったものであり、請求項１６に係る発明の実施形態である。本実施形態は、既に説明した各実施形態のいずれに適用することも可能である。

【０２５８】図４１は、本実施形態において無線端末がハンドオフを行う場合の動作を示すフローチャートである。この図に示すように、無線端末は、ハンドオフを開始すると、新たな在圏先である無線基地局を選択する（ステップＳ５０１）。ここで、ハンドオフ開始の契機としては、例えば無線基地局からの報知信号を連続ｊ回受信しない場合を設定することができる。また、新たな在圏先無線基地局の選択方法としては、例えば、一定期間、無線パケット転送システムにおける全無線チャネル周波数をモニタリングして上記報知信号の受信レベルが最も大きい無線基地局を選択するという方法を採ることができる。次いで無線端末は、直接転送テーブルにおける全ての無線端末の登録を抹消する（ステップＳ５０２）。

【０２５９】本実施形態によれば、無線端末は、ハンドオフ前に他の無線端末と直接転送をしていた場合でも、ハンドオフ後は中継転送方法により当該他の無線端末宛てのパケット転送を行うこととなる。

【０２６０】Ｊ．第９の実施形態

本実施形態は、フラグメント分割送信方法によりパケット転送を行う無線パケット転送システムに本発明を適用したものであり、請求項１７に係る発明の実施形態である。なお、本実施形態は、既に説明した各実施形態のいずれに適用することも可能である。

【０２６１】図４２に本実施形態において無線端末が行うデータパケットの送信動作の動作フローを示す。無線端末は、データパケットの送信時、当該データパケットを直接転送方法により転送するか中継転送方法により転送するかを決定する（ステップＳ６０１）。なお、この転送方法の決定をするための具体的処理については既に各実施形態において説明した通りである。

【０２６２】そして、直接転送方法によりデータパケットの転送を行うこととした場合、無線端末は、当該データパケットのパケット長が直接転送の場合のフラグメント閾値を越えているか否かを判断し（ステップＳ６０２）、越えている場合にはパケット長が当該フラグメント閾値以下となるように当該データパケットの分割を行う（ステップＳ６０３）。

【０２６３】一方、中継転送方法によりデータパケットの転送を行うこととした場合、無線端末は、当該データパケットのパケット長が中継転送の場合のフラグメント閾値を越えているか否かを判断し（ステップＳ６０４）、越えている場合にはパケット長が当該フラグメント閾値以下となるように当該データパケットの分割を行う（ステップＳ６０５）。

【０２６４】以上の処理を経た後、直接転送方法による場合にはデータパケットの転送種別を“００”とし、中継転送方法による場合にはデータパケットの転送種別を“０１”とし、データパケットの送信を行う（ステップＳ６０６）。

【０２６５】なお、直接転送方法および中継転送方法の具体的処理については既に各実施形態において説明した通りである。

【０２６６】本実施形態によれば、直接転送用のフラグメント閾値を無線端末と無線端末との間の伝送路に適した値に設定し、かつ、中継転送用のフラグメント閾値を無線端末と無線基地局との間の伝送路に適した値に設定することができ、これにより高いスループットを得ることができる。

【０２６７】Ｋ．第１０の実施形態

本実施形態は、ＲＴＳ／ＣＴＳランダムアクセス方法によりパケット転送を行う無線パケット転送システムに本

発明を適用したものであり、請求項１８に係る発明の実施形態である。なお、本実施形態は、既に説明した各実施形態のいずれに適用することも可能である。

【０２６８】図４３にＲＴＳ／ＣＴＳランダムアクセス方法によるデータパケット転送の動作シーケンスを示す。図４３において、送信元無線端末Ａは、ＲＴＳ信号に送信元アドレスとパケット長を付与する。そして、中継転送方法による転送を行う場合には転送種別“０１”をＲＴＳ信号に付与して無線基地局に送信し、直接転送方法による転送を行う場合には転送種別“００”をＲＴＳ信号に付与して宛先無線端末に送信する。図４３に示す動作例では、無線端末Ａは、直接転送方法による転送を行うべく、転送種別“００”をＲＴＳ信号に付与して無線端末Ｂ宛てに送信している。

【０２６９】無線端末Ｂは、転送種別が“００”であるＲＴＳ信号を受信すると、ＲＴＳ信号の送信元無線端末Ａのアドレスを許可アドレスとし、かつ、ＲＴＳ信号に付与されたパケット長を含んだＣＴＳ信号を送信する。なお、転送種別が“０１”であるＲＴＳ信号を無線基地局が受信した場合にも、当該無線基地局によって同様なＣＴＳ信号が送信される。

【０２７０】各無線端末は、上記ＣＴＳ信号を受信すると、当該ＣＴＳ信号の許可アドレスが自局のアドレスと一致しているか否かを判断する。

【０２７１】図４３に示す例では、上記ＲＴＳ信号の送信元である無線端末Ａは、ＣＴＳ信号の許可アドレスが自局のアドレスと一致していることを確認すると、転送種別を“００”とする無線端末Ｂ宛てのデータパケットを送信する。無線端末Ｂはこのデータパケットを受信すると、無線端末Ａ宛てにＡＣＫ信号を送信する。無線端末Ａは、このＡＣＫ信号を受信することにより、送信成功を認識する。

【０２７２】一方、他の無線端末Ｃは、上記ＣＴＳ信号の許可アドレスが自局のアドレスと一致していないため、ＣＴＳ信号に含まれるパケット長に相当する期間、データパケットおよびＲＴＳ信号の送信を行わない。

【０２７３】以上がＲＴＳ／ＣＴＳランダムアクセス方法によるデータパケット転送の動作の概要である。この方法によれば、いわゆる隠れ端末の問題を解決することができる。

【０２７４】図４４は本実施形態における無線端末のデータパケットの送信動作を示すフローチャートである。本実施形態において無線端末は、転送すべきデータパケットが生じると、リトライカウンタを「１」に設定した後（ステップＳ７０１）、データパケット転送を直接転送方法により行うか中継転送方法により行うかを決定する（ステップＳ７０２）。

【０２７５】データパケット転送を直接転送方法により行うものと決定した場合、当該データパケットのパケット長が直接転送用ＲＴＳ閾値を越えているか否かを判断し（ステップＳ７０３）、この判断結果が「ＹＥＳ」の場合はステップＳ７０５へ、「ＮＯ」の場合はステップＳ７１０へと進む。一方、データパケット転送を中継転送方法により行うものと決定した場合、当該データパケットのパケット長が中継転送用ＲＴＳ閾値を越えているか否かを判断し（ステップＳ７０４）、この判断結果が「ＹＥＳ」の場合はステップＳ７０５へ、「ＮＯ」の場合はステップＳ７１０へと進む。

【０２７６】次にパケット長が直接転送用ＲＴＳ閾値または中継転送用ＲＴＳ閾値を越えており、ステップＳ７０３またはＳ７０４からステップＳ７０５に進むと、無線端末はＲＴＳ信号を送信する。ここで、直接転送の場合は、転送種別“００”をＲＴＳ信号に付与して送信し、中継転送の場合は転送種別“０１”をＲＴＳ信号に付与して送信する。

【０２７７】このＲＴＳ信号の送信を終えると、ＣＴＳ信号を受信したか否かを判断する（ステップＳ７０６）。そして、ＣＴＳ信号を受信しない場合はリトライカウンタの値が所定値Ｋ未満か否かを判断し（ステップＳ７０７）、Ｋ未満である場合には、ランダムに決定される時間だけ待機するとともにリトライカウンタを「１」だけ増加させ（ステップＳ７０８）、再びＲＴＳ信号の送信（ステップＳ７０５）を繰り返す。また、ＣＴＳ信号を受信した場合であっても、そのＣＴＳ信号に含まれる許可アドレスが自局のアドレスと一致していない場合も基本的に同様であるが（ステップＳ７０９）、この場合にはＣＴＳ信号中に含まれるパケット長に相当する時間だけＲＴＳ信号の送信を見合せる。

【０２７８】上記ＲＴＳ信号の送信後、ＣＴＳ信号を受信し、かつ、ＣＴＳ信号に含まれる宛先アドレスが自局のアドレスと一致している場合には、直接転送方法または中継転送方法のうちステップＳ７０２において決定した転送方法により、データパケットの送信を行う（ステップＳ７１０）。

【０２７９】自局宛てのＣＴＳ信号を受信することなく、リトライカウンタの値が所定値Ｋに達した場合は、データパケットを廃棄する（ステップＳ７１１）。

【０２８０】以上が本実施形態における無線端末のデータパケットの送信動作である。本実施形態によれば、直接転送の場合と中継転送の場合とでＲＴＳ閾値を別にしているので、直接転送用ＲＴＳ閾値を無線端末と無線端末との間の伝送路に適した値とし、中継転送用ＲＴＳ閾値を無線端末と無線基地局との間の伝送路に適した値とすることにより、高いスループットを得ることができる。

【０２８１】

【発明の効果】（１）請求項１～１６に係る発明によれば、直接転送方法によるパケット転送が失敗に終わる可能性が低く、その一方、可能な限り直接転送方法によるパケット転送を行うことができ、高いスループットが得

られ、かつ、可能な限り短い転送時間でパケット転送を行うことができるという効果が得られる。

【０２８２】（２）請求項１２に係る発明によれば、宛先無線端末がパワーセーブモードで動作しているときは、当該宛先無線端末がたとえ直接転送テーブルに登録されていたとしても、中継転送方法が適用される。従って、本発明によれば、パワーセーブモードで動作している宛先無線端末に直接転送方法によるパケット転送を行って失敗するという事態を避けることができ、スループットの向上を図ることができるという効果が得られる。

【０２８３】（３）請求項１３に係る発明によれば、宛先無線端末が認証を拒否したとき直接転送方法によりパケットを送信すると宛先無線端末側で廃棄されるという問題点が解決され、これにより高いスループットが得られ、かつ、可能な限り短いパケット転送時間でパケット転送を行うことができるという効果が得られる。

【０２８４】（４）請求項１４に係る発明によれば、直接転送を行った場合にブロードキャストパケットを受信できない無線端末に対しても中継転送によりパケット転送を行うことができ、パケット転送を信頼性を高めることができるという効果が得られる。

【０２８５】（５）請求項１５に係る発明によれば、無線端末が無線基地局のサービスエリアの圏外に位置する場合には、宛先無線端末が直接転送テーブルに登録されているか否かに拘わらず、直接転送方法によりパケットの転送を行うので、中継転送方法による無駄なパケット転送を防止することができ、スループットの向上とパケット転送時間の短縮を図ることができるという効果が得られる。

【０２８６】（６）請求項１６に係る発明によれば、無線基地局の切り替え後は、まず、中継転送方法によりパケット転送が行われるので、無線基地局の切り替え後の直接転送が行われて失敗するという事態の発生を防止し、スループットの向上とパケット転送時間の短縮を図ることができるという効果が得られる。

【０２８７】（７）請求項１７に係る発明によれば、中継転送方法の場合と直接転送方法の場合とで各々に適したフラグメント閾値を使用することができるので、スループットの向上を図ることができるという効果が得られる。

【０２８８】（８）請求項１８に係る発明によれば、中継転送方法の場合と直接転送方法の場合とで各々に適したＲＴＳ閾値を使用することができるので、スループットの向上を図ることができるという効果が得られる。

【図面の簡単な説明】

【図１】　この発明の各実施形態が適用されるネットワークの構成例を示す図である。

【図２】　この発明の第１の実施形態において無線端末と無線端末との間または無線端末と無線基地局との間で授受される無線パケットのフォーマットを示す図である。

【図３】　同実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャートである。

【図４】　同実施形態における直接転送テーブルの内容を例示した図である。

【図５】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャートである。

【図６】　同実施形態において無線基地局によって行われるデータパケットの中継動作を示すフローチャートである。

【図７】　同実施形態において無線端末が直接転送テーブルに登録された無線端末宛てにデータパケットを転送する動作例を示す動作シーケンス図である。

【図８】　同実施形態において無線端末が他の無線端末を直接転送テーブルに登録する動作例を示す動作シーケンス図である。

【図９】　同実施形態において無線端末が直接転送テーブルに登録されていない無線端末宛てにデータパケットを転送する動作例を示す動作シーケンス図である。

【図１０】　同実施形態において無線端末が直接転送テーブルに登録された無線端末宛てにデータパケットを転送するが、宛先無線端末が当該データパケットを受信できない場合の動作例を示す動作シーケンス図である。

【図１１】　同実施形態において隣接する各無線基地局に収容されている各無線端末がデータパケット転送を行う場合の動作を示す図である。

【図１２】　同実施形態において無線端末と有線端末との間で行われるデータパケット転送の動作を示す動作シーケンス図である。

【図１３】　この発明の第２の実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャートである。

【図１４】　同実施形態において２台の無線端末が各々の直接転送テーブルに他方の無線端末を登録しているが、一方の無線端末が送信したデータパケットを他方の無線端末が閾値Ｌ２未満の受信レベルで受信した場合の動作例を示す動作シーケンス図である。

【図１５】　この発明の第３の実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャート（前半）である。

【図１６】　同実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャート（後半）である。

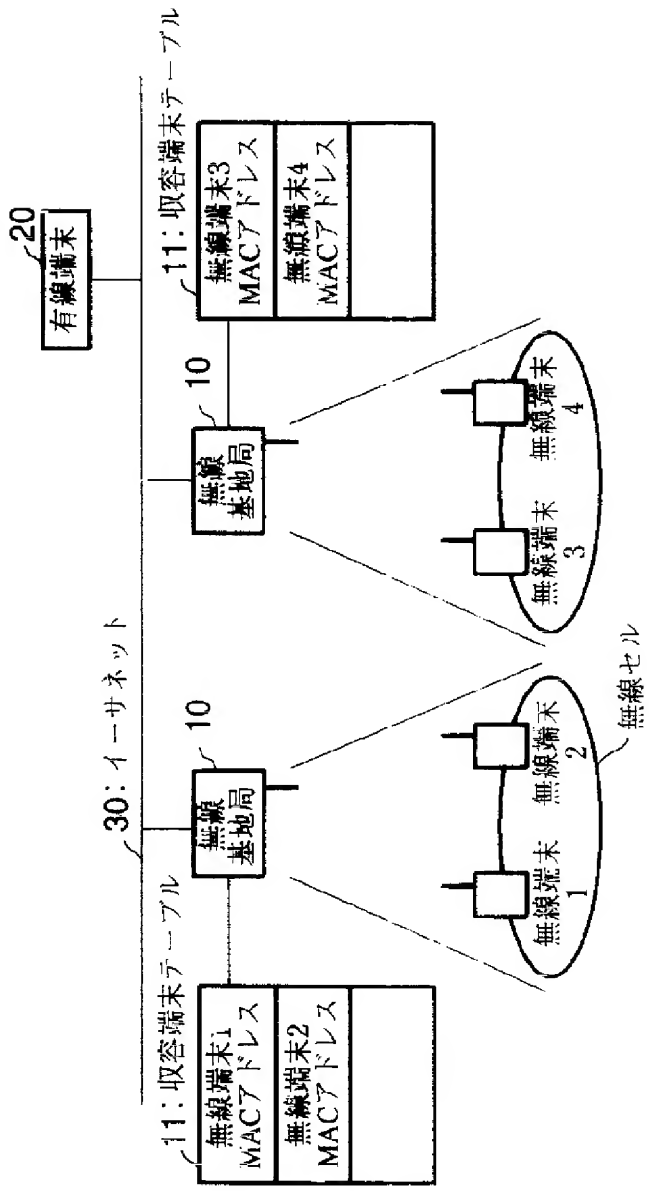
【図１７】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャートである。

【図１８】　同実施形態において監視タイマがタイムオーバーとなったときの動作を示すフローチャートであ

る。
【図１９】　同実施形態において無線端末が直接転送テーブルに登録された無線端末宛てにデータパケットを転送する動作例を示す動作シーケンス図である。
【図２０】　同実施形態において無線端末が他の無線端末を直接転送テーブルに登録する動作例を示す動作シーケンス図である。
【図２１】　同実施形態において無線端末が直接転送テーブルに登録された無線端末宛てにデータパケットを転送するが、宛先無線端末が当該データパケットを閾値Ｌ２未満の受信レベルで受信した場合の動作例を示す動作シーケンス図である。
【図２２】　同実施形態において無線端末が直接転送テーブルに登録されており、監視タイマがタイムオーバーとなったときの動作例を示す動作シーケンス図である。
【図２３】　この発明の第４の実施形態において無線端末と無線端末との間または無線端末と無線基地局との間で授受される無線パケットのフォーマットを示す図である。
【図２４】　同実施形態における直接転送テーブルの内容を例示した図である。
【図２５】　同実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャート（前半）である。
【図２６】　同実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャート（後半）である。
【図２７】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャートである。
【図２８】　同実施形態において無線端末がアクティブモードからパワーセーブモードに遷移したときの動作例を示す動作シーケンス図（前半）である。
【図２９】　同実施形態において無線端末がアクティブモードからパワーセーブモードに遷移したときの動作例を示す動作シーケンス図（後半）である。
【図３０】　この発明の第５の実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャート（前半）である。
【図３１】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャート（後半）である。
【図３２】　同実施形態において無線端末Ａの直接転送テーブルに無線端末Ｂが登録され、かつ、無線端末Ｂが未認証のとき、無線端末Ｂが認証を許可する場合の動作例を示す動作シーケンス図である。
【図３３】　同実施形態において無線端末Ａの直接転送テーブルに無線端末Ｂが登録され、かつ、無線端末Ｂが未認証のとき、無線端末Ｂが認証を拒否する場合の動作例を示す動作シーケンス図である。
【図３４】　この発明の第６の実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャート（前半）である。
【図３５】　同実施形態において無線端末によって行われるデータパケットの受信動作を示すフローチャート（後半）である。
【図３６】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャート（前半）である。
【図３７】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャート（後半）である。
【図３８】　同実施形態においてブロードキャストが行われる場合の動作例を示す動作シーケンス図である。
【図３９】　この発明の第７の実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャート（前半）である。
【図４０】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャート（後半）である。
【図４１】　この発明の第８の実施形態において無線端末によって行われるハンドオフ時の動作を示すフローチャートである。
【図４２】　この発明の第９の実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャートである。
【図４３】　この発明の第１０の実施形態が適用されるＲＴＳ／ＣＴＳランダムアクセス方法によるデータパケット転送の動作例を示す動作シーケンス図である。
【図４４】　同実施形態において無線端末によって行われるデータパケットの送信動作を示すフローチャートである。
【図４５】　直接転送方法と中継転送方法を説明する図である。
【符号の説明】

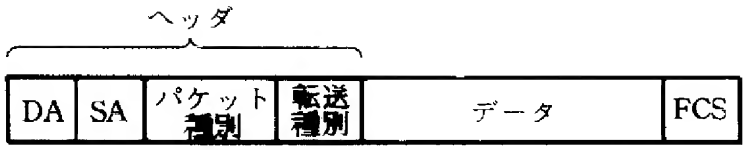
１０	無線基地局
１１	収容端末テーブル
１～４、Ａ、Ｂ、Ｃ	無線端末
２０、Ｚ	有線端末
３０	イーサネット

【図１】


20
有線端末
11：収容端末テーブル
無線端末3
MACアドレス
無線端末4
MACアドレス
10
無線基地局
無線端末
4
無線端末
3
30：イーサネット
10
無線基地局
無線端末
2
無線端末
1
無線セル
11：収容端末テーブル
無線端末1
MACアドレス
無線端末2
MACアドレス

【図２】

(a) データパケット

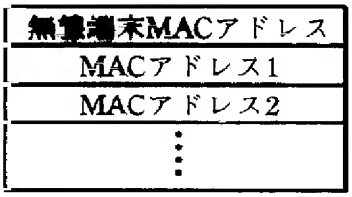


パケット種別=0000（データパケット）
DA：宛先アドレス
SA：送信元アドレス
FCS：フレームチェックシーケンス

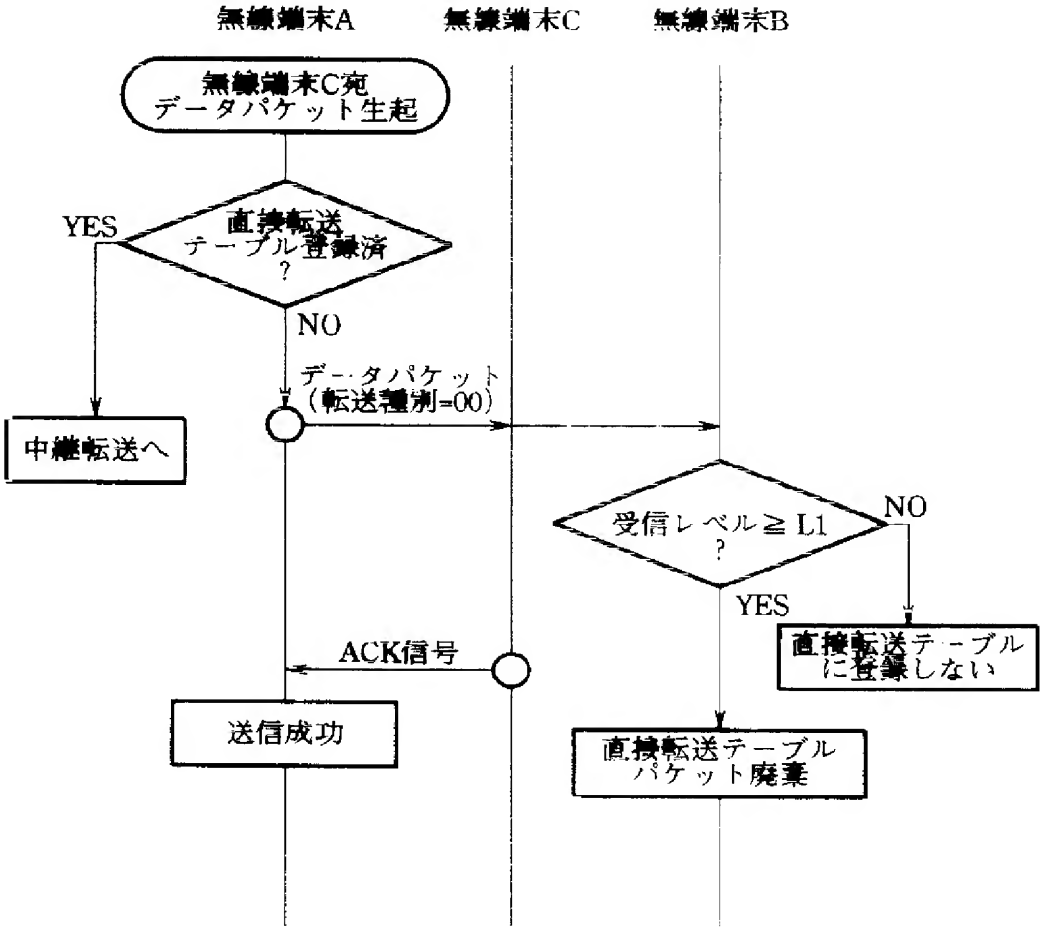
(b) ACK信号

パケット種別=0001（ACK信号）
DA：宛先アドレス
FCS：フレームチェックシーケンス

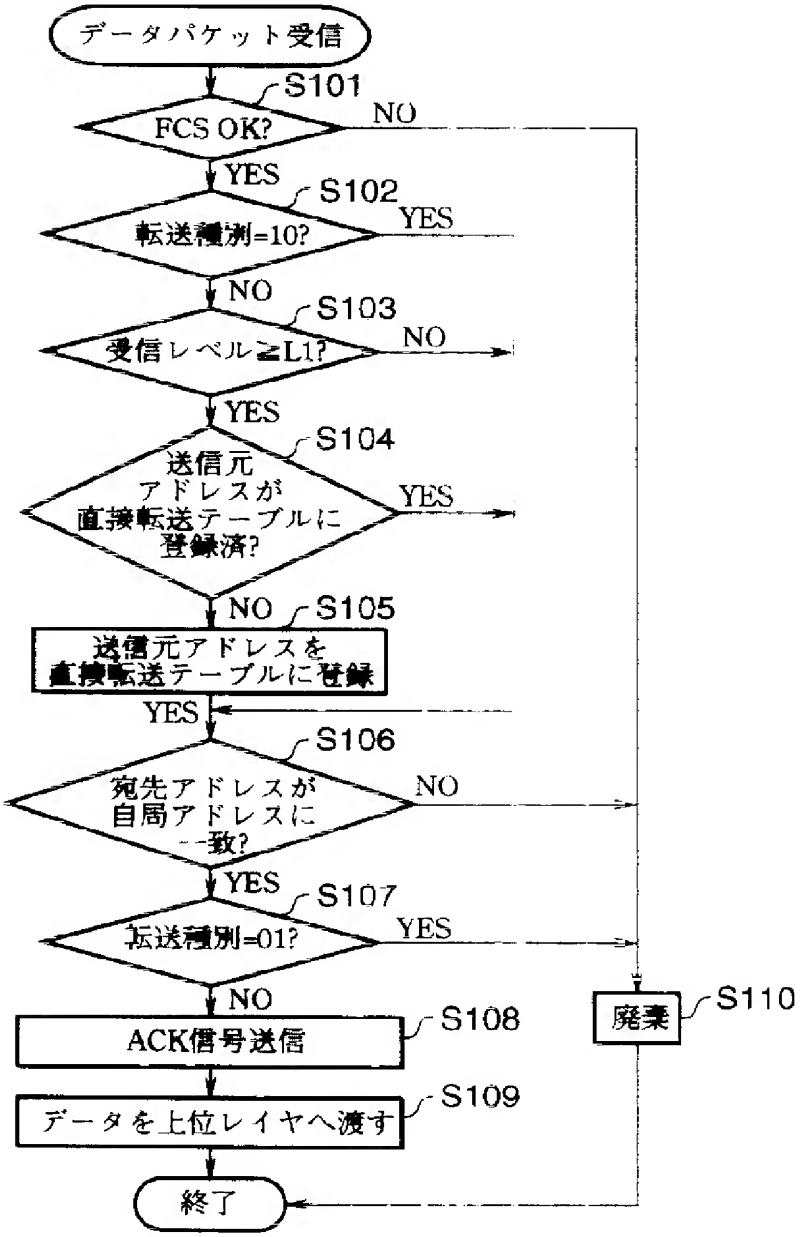
【図４】



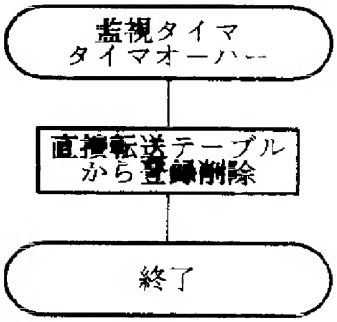
【図８】



【図３】



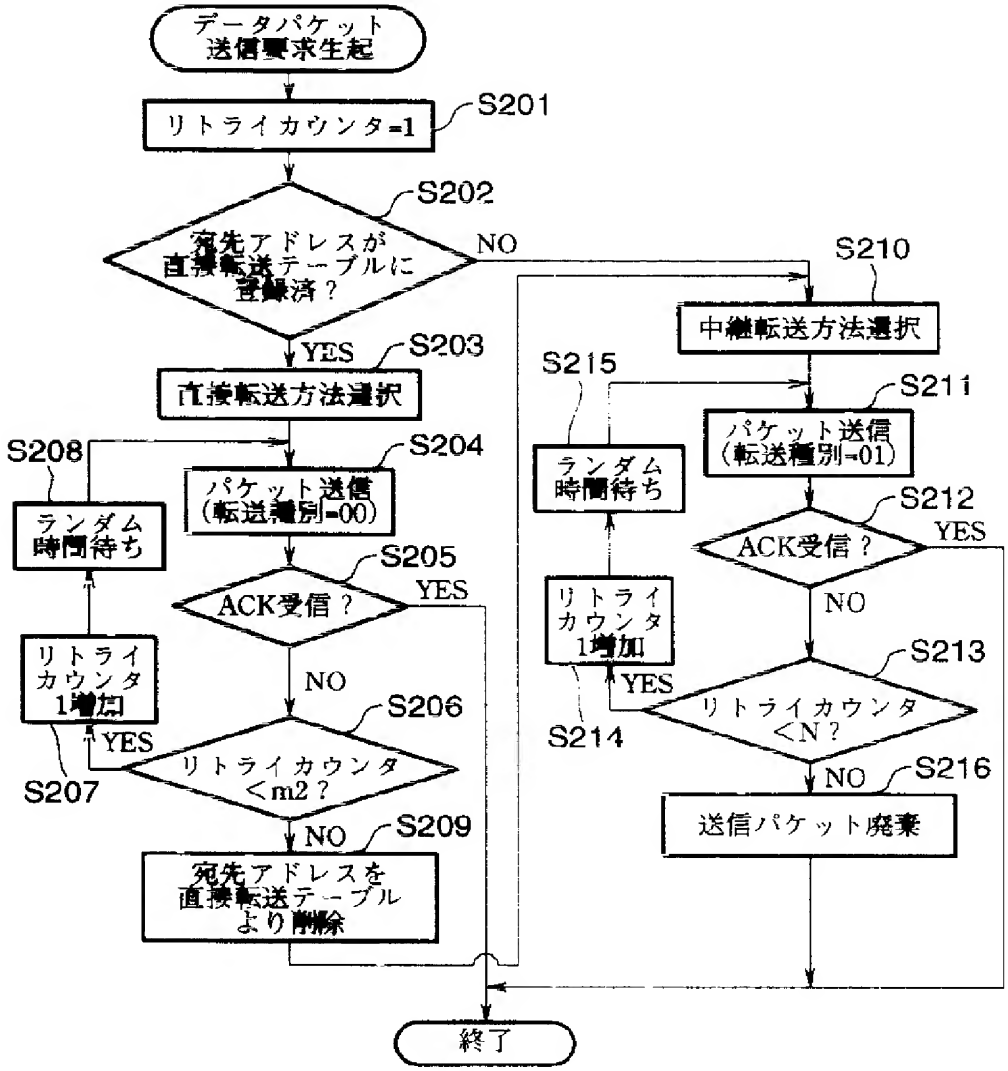
【図１８】



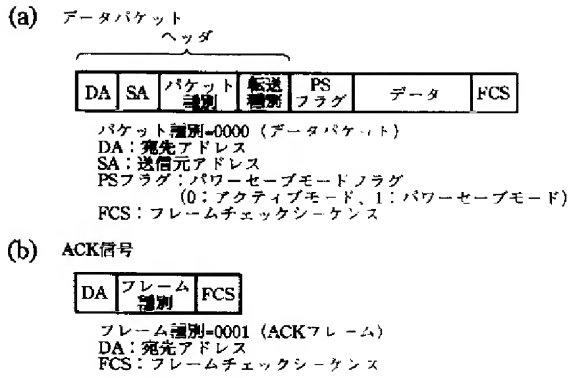
【図２４】

無線端末MACアドレス	パワーセーブモードフラグ
MACアドレス2	1
MACアドレス1	0
⋮	

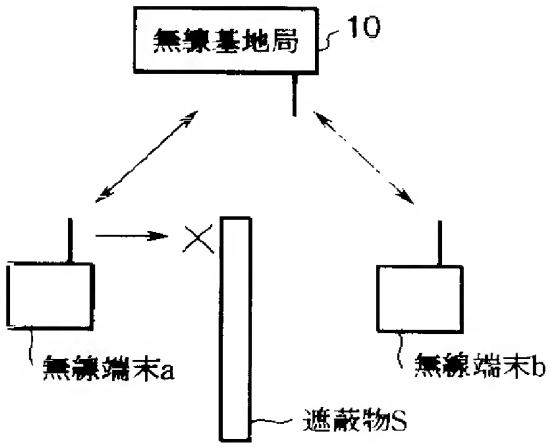
【図５】


データパケット
送信要求生起
リトライカウンタ=1
S201
S202
宛先アドレスが
直接転送テーブルに
登録済？
NO
YES
S203
直接転送方法選択
S204
パケット送信
(転送種別=00)
S205
ACK受信？
YES
NO
S206
リトライカウンタ
＜m2？
YES
S207
リトライ
カウンタ
1増加
S208
ランダム
時間待ち
NO
S209
宛先アドレスを
直接転送テーブル
より削除
S210
中継転送方法選択
S211
パケット送信
(転送種別=01)
S212
ACK受信？
YES
NO
S213
リトライカウンタ
＜N？
YES
S214
リトライ
カウンタ
1増加
S215
ランダム
時間待ち
NO
S216
送信パケット廃棄
終了

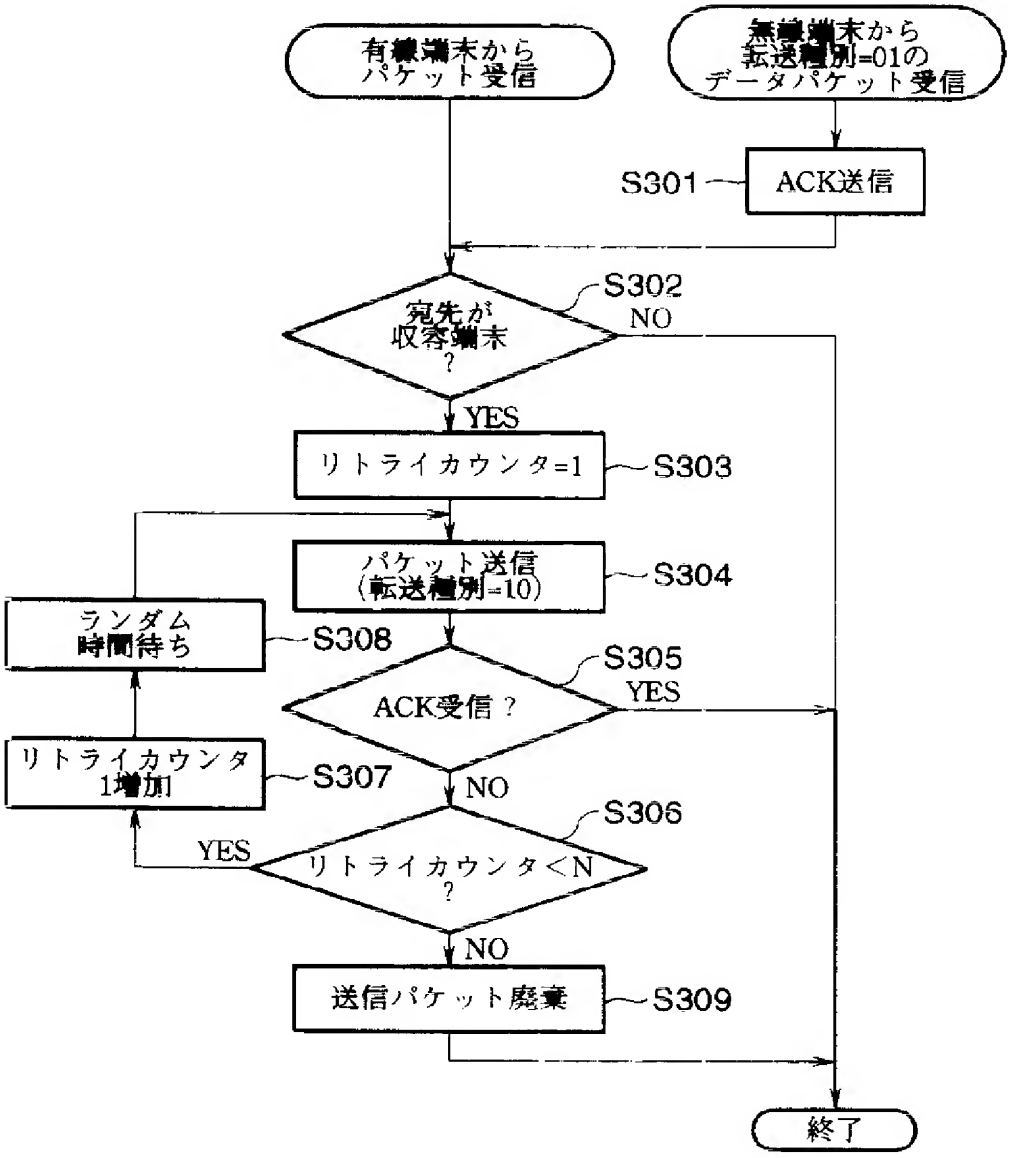
【図２３】


(a)
データパケット
ヘッダ
DA
SA
パケット種別
転送種別
PSフラグ
データ
FCS
パケット種別=0000（データパケット）
DA：宛先アドレス
SA：送信元アドレス
PSフラグ：パワーセーブモードフラグ
(0：アクティブモード、1：パワーセーブモード)
FCS：フレームチェックシーケンス
(b)
ACK信号
DA
フレーム種別
FCS
フレーム種別=0001（ACKフレーム）
DA：宛先アドレス
FCS：フレームチェックシーケンス

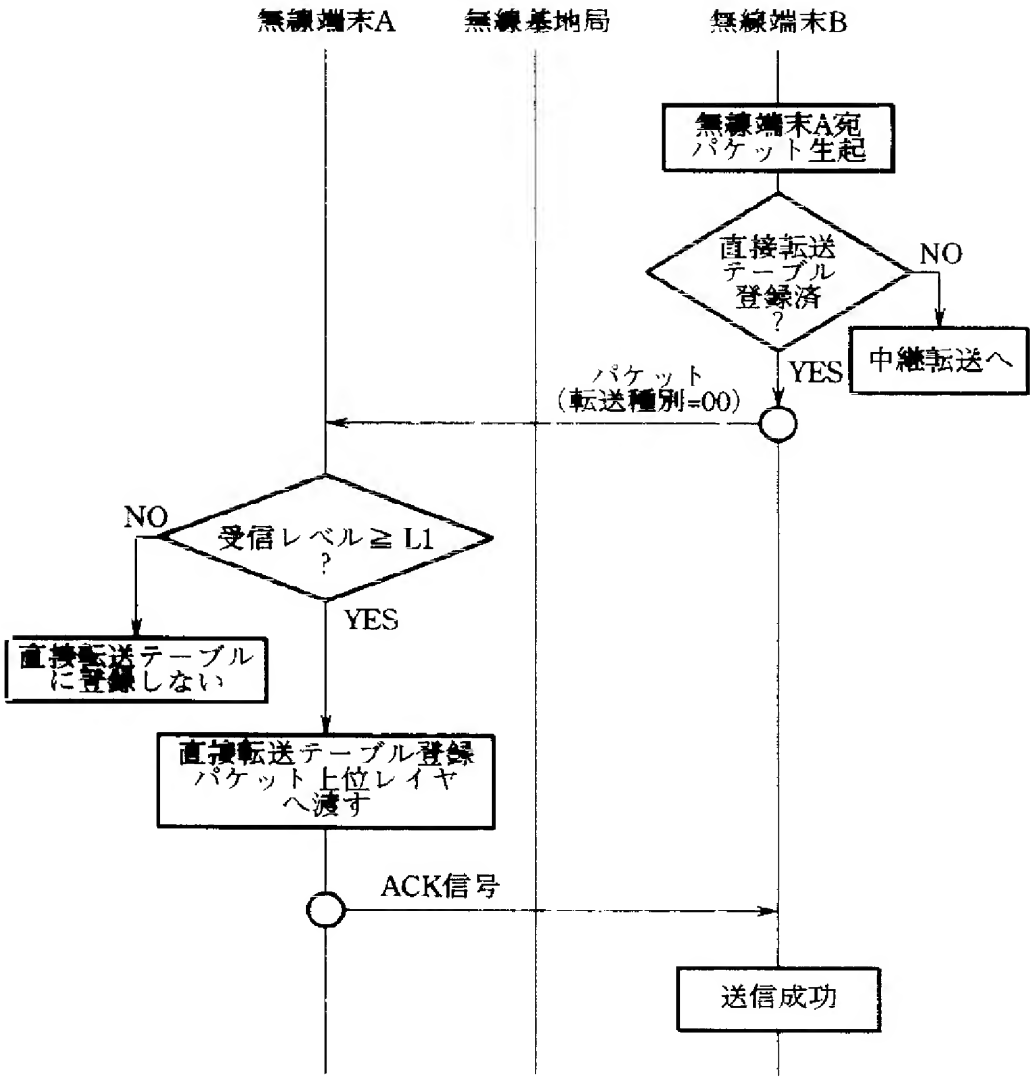
【図４５】


無線基地局
10
無線端末a
無線端末b
遮蔽物S

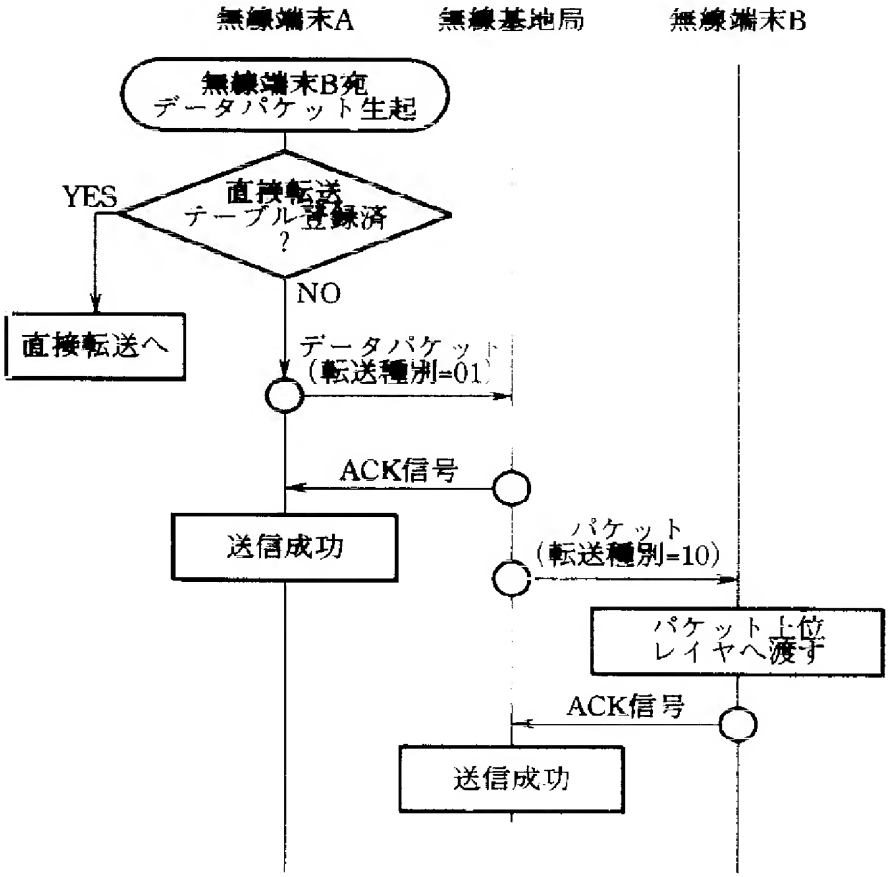
【図６】


有線端末から
パケット受信
無線端末から
転送種別=01の
データパケット受信
S301
ACK送信
S302
宛先が
収容端末
?
NO
YES
リトライカウンタ=1
S303
パケット送信
(転送種別=10)
S304
ランダム
時間待ち
S308
S305
ACK受信？
YES
リトライカウンタ
1増加
S307
NO
S306
YES
リトライカウンタ＜N
?
NO
送信パケット廃棄
S309
終了

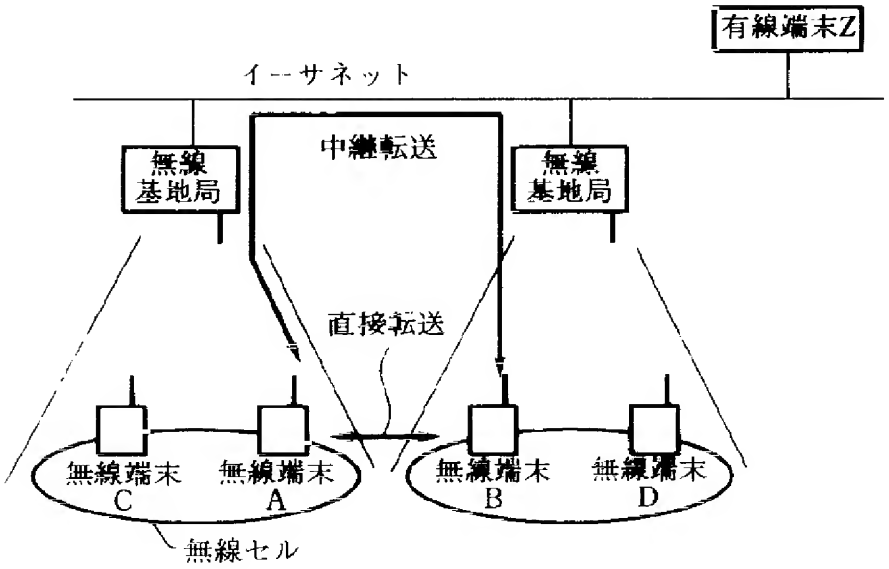
【図７】


無線端末A
無線基地局
無線端末B
無線端末A宛
パケット生起
直接転送
テーブル
登録済
?
NO
中継転送へ
YES
パケット
(転送種別=00)
NO
受信レベル≧ L1
?
YES
直接転送テーブル
に登録しない
直接転送テーブル登録
パケット上位レイヤ
へ渡す
ACK信号
送信成功

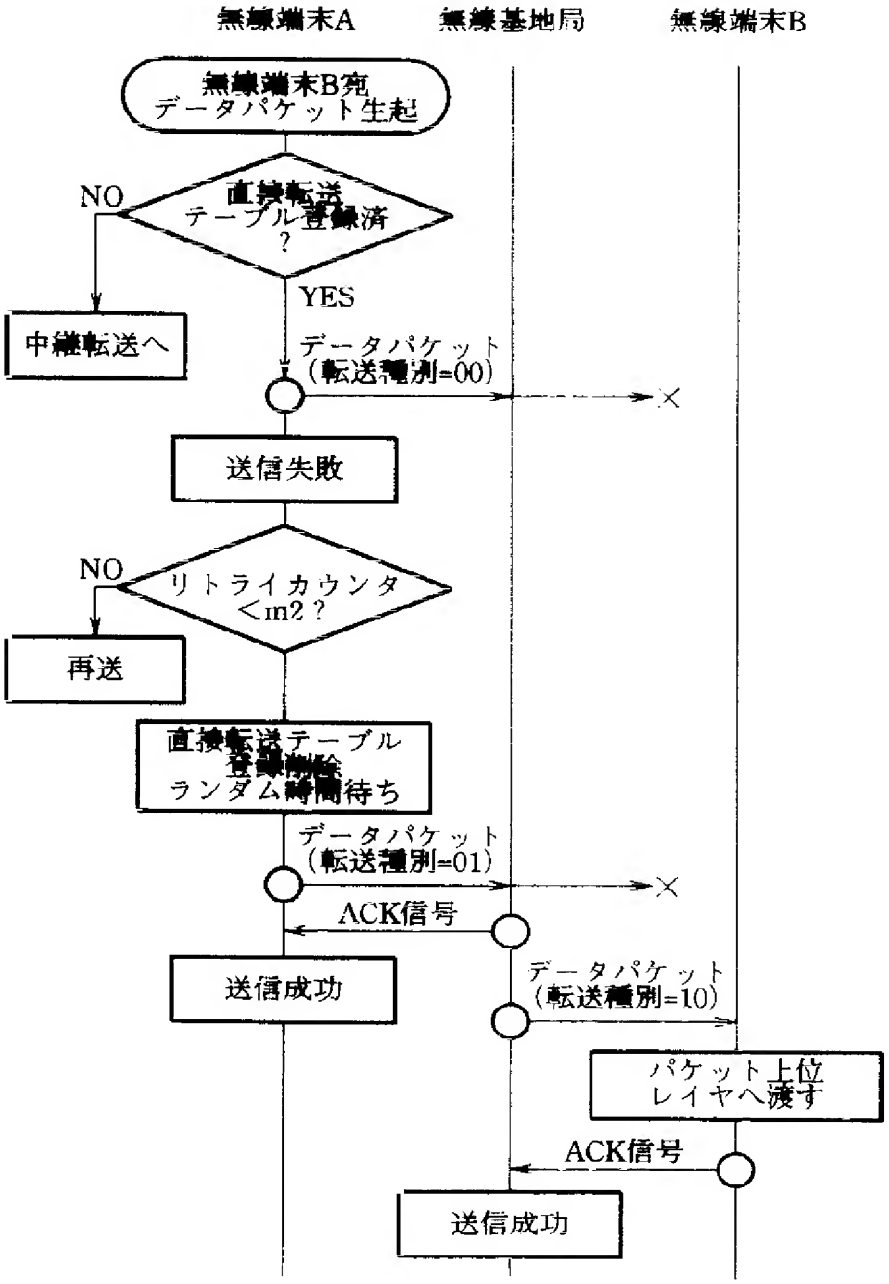
【図９】


無線端末A
無線基地局
無線端末B
無線端末B宛
データパケット生起
直接転送
テーブル登録済
?
YES
NO
直接転送へ
データパケット
(転送種別=01)
ACK信号
送信成功
パケット
(転送種別=10)
パケット上位
レイヤへ渡す
ACK信号
送信成功

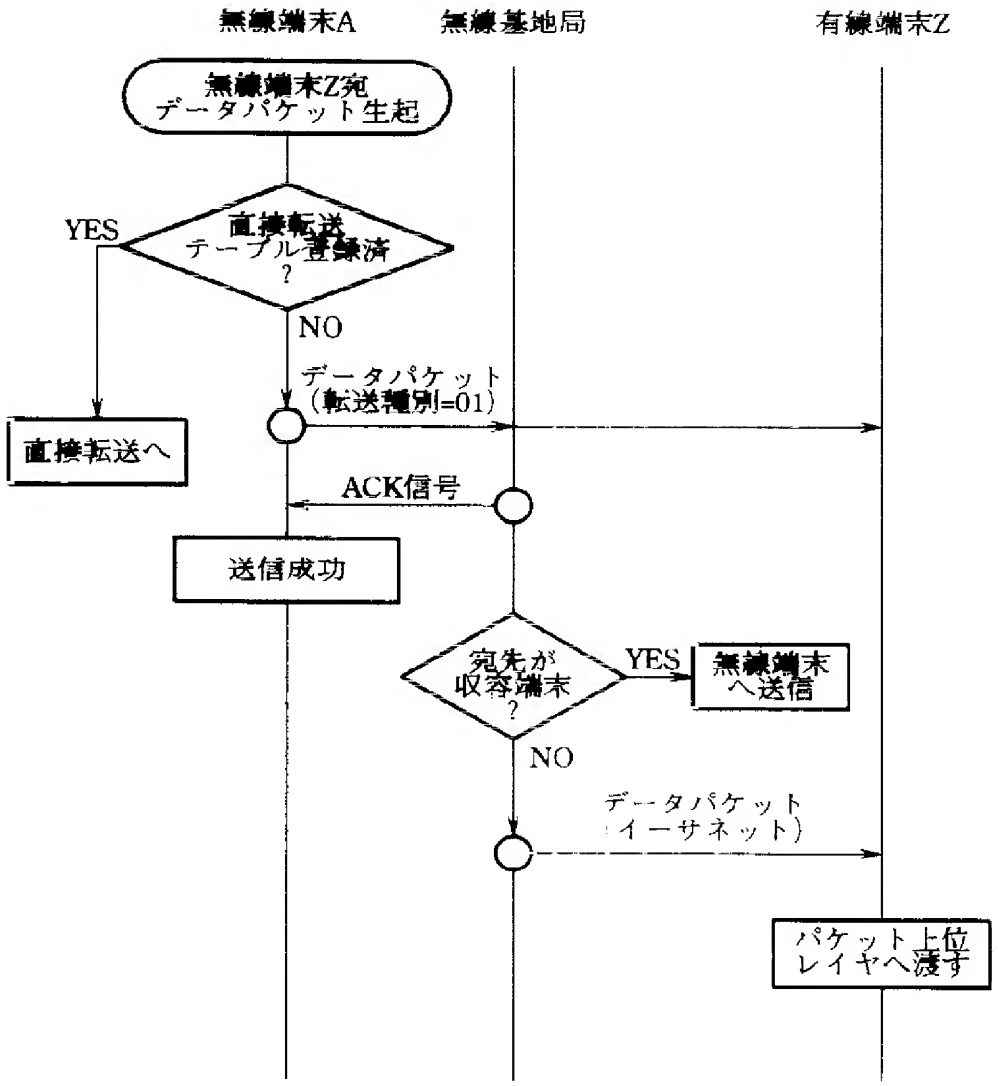
【図１１】


有線端末Z
イーサネット
無線
基地局
中継転送
無線
基地局
直接転送
無線端末
C
無線端末
A
無線端末
B
無線端末
D
無線セル

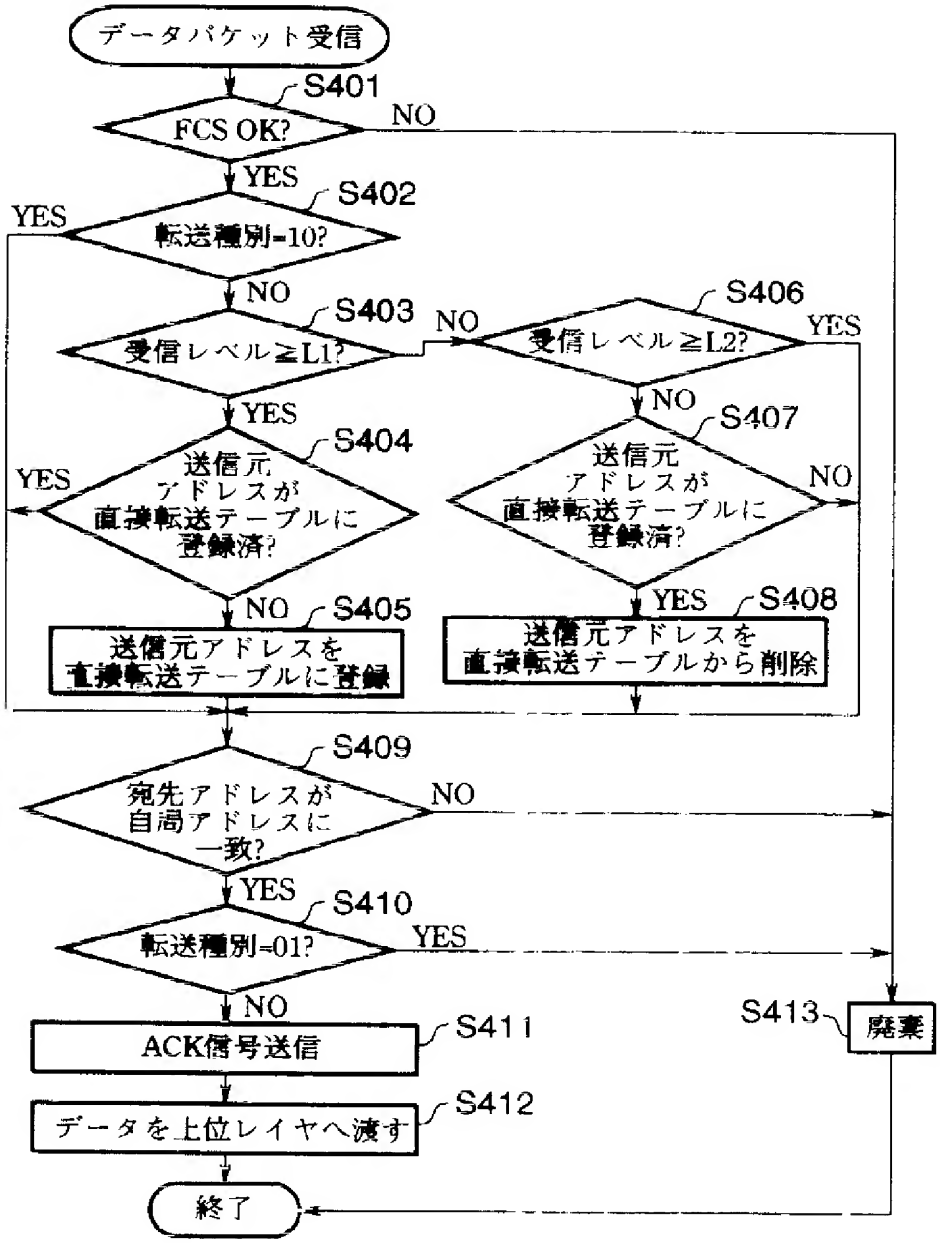
【図１０】


無線端末A
無線基地局
無線端末B
無線端末B宛
データパケット生起
NO
直接転送
テーブル登録済
？
YES
中継転送へ
データパケット
（転送種別=00）
送信失敗
NO
リトライカウンタ
＜m2？
再送
直接転送テーブル
登録削除
ランダム時間待ち
データパケット
（転送種別=01）
ACK信号
送信成功
データパケット
（転送種別=10）
パケット上位
レイヤへ渡す
ACK信号
送信成功

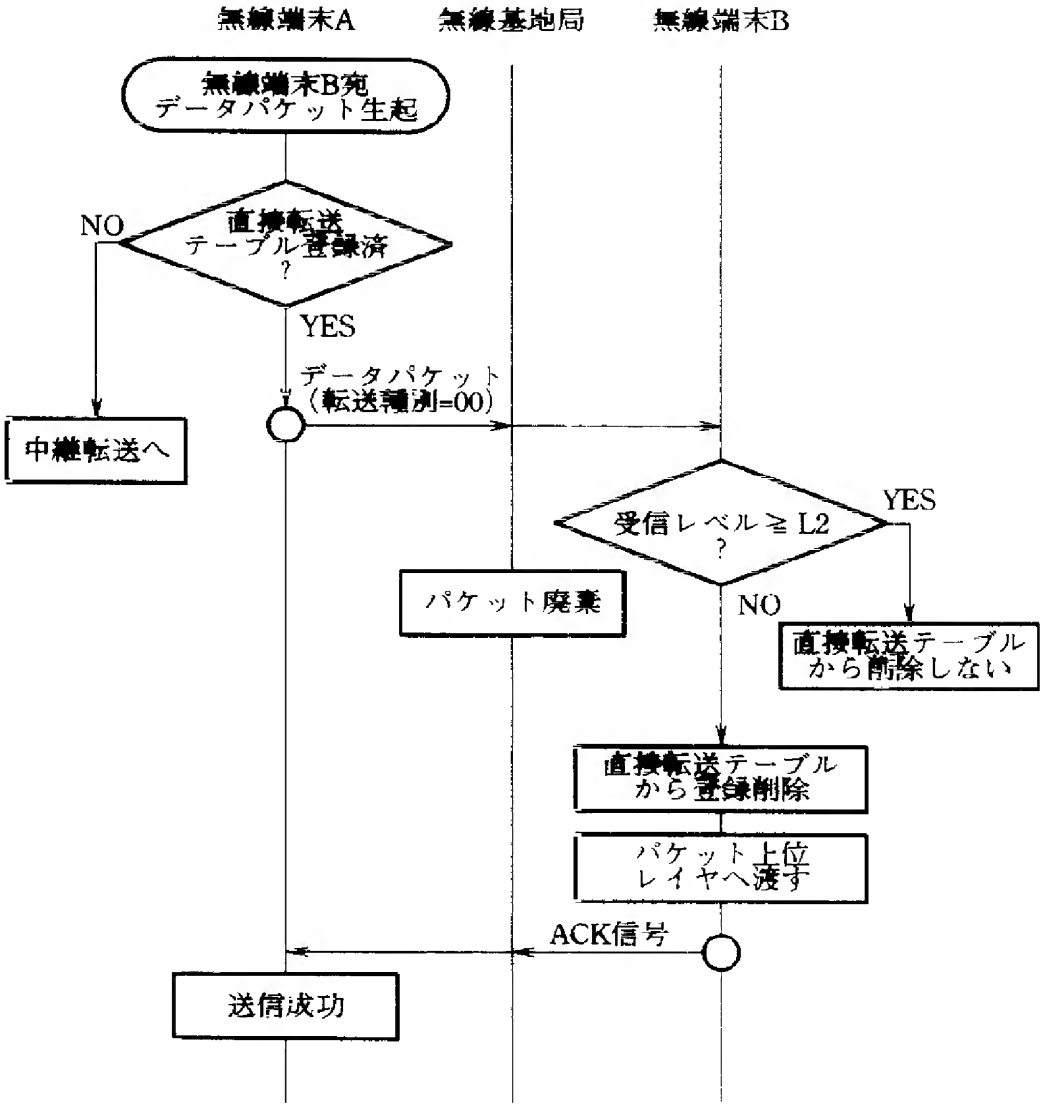
【図１２】


無線端末A
無線基地局
有線端末Z
無線端末Z宛
データパケット生起
直接転送
テーブル登録済
?
YES
NO
データパケット
(転送種別=01)
直接転送へ
ACK信号
送信成功
宛先が
収容端末
?
YES
無線端末
へ送信
NO
データパケット
(イーサネット)
パケット上位
レイヤへ渡す

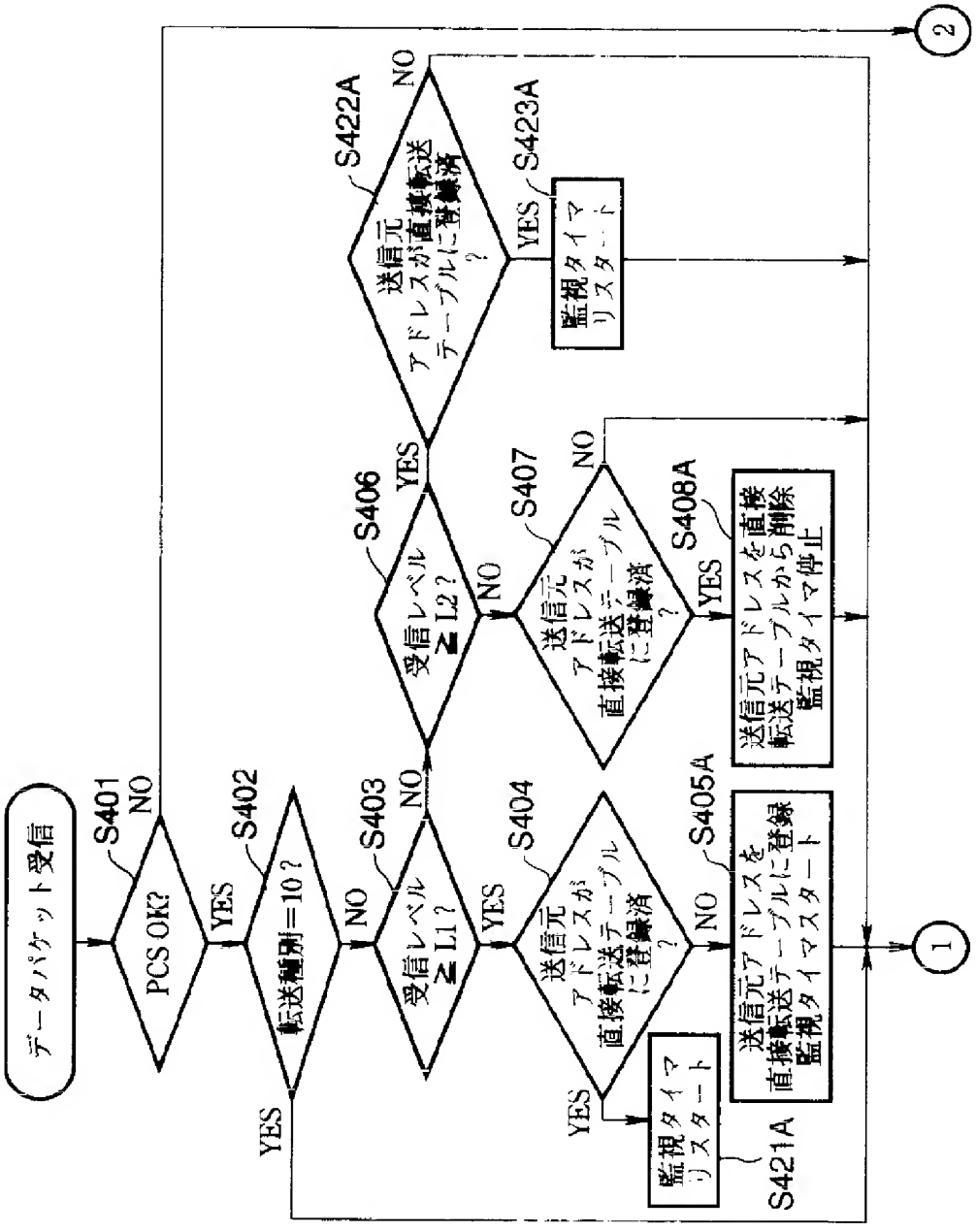
【図１３】


データパケット受信
S401
FCS OK?
NO
YES
S402
転送種別=10?
YES
NO
S403
受信レベル≧L1?
NO
S406
受信レベル≧L2?
YES
YES
S404
送信元アドレスが直接転送テーブルに登録済?
YES
NO
S405
送信元アドレスを直接転送テーブルに登録
NO
S407
送信元アドレスが直接転送テーブルに登録済?
NO
YES
S408
送信元アドレスを直接転送テーブルから削除
S409
宛先アドレスが自局アドレスに一致?
NO
YES
S410
転送種別=01?
YES
NO
S411
ACK信号送信
S412
データを上位レイヤへ渡す
S413
廃棄
終了

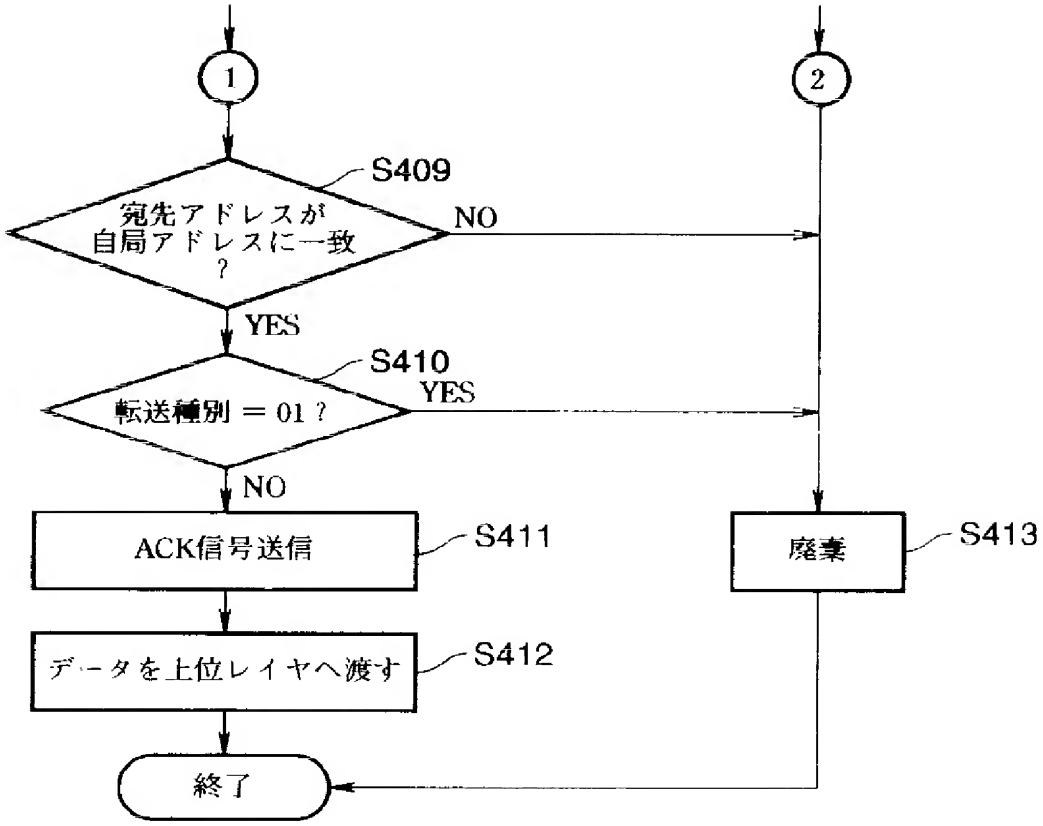
【図１４】


無線端末A
無線基地局
無線端末B
無線端末B宛
データパケット生起
直接転送
テーブル登録済
?
NO
YES
データパケット
(転送種別=00)
中継転送へ
受信レベル≧L2
?
YES
NO
パケット廃棄
直接転送テーブル
から削除しない
直接転送テーブル
から登録削除
パケット上位
レイヤへ渡す
ACK信号
送信成功

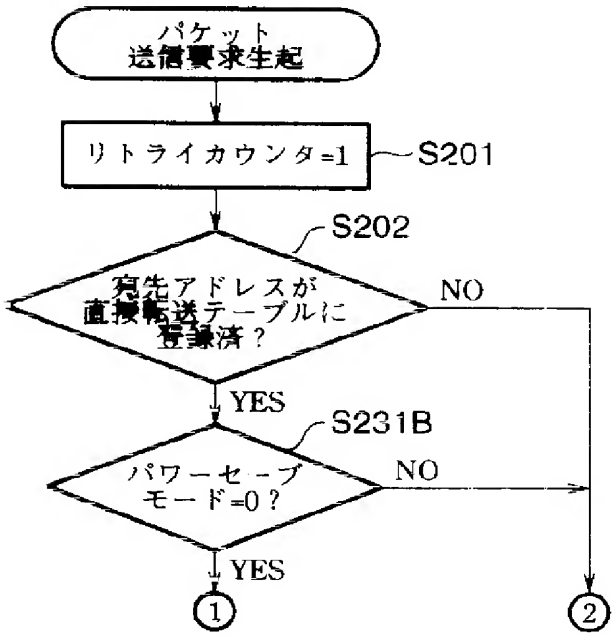
【図１５】


データパケット受信
S401
PCS OK?
NO
YES
S402
転送種別=10？
NO
YES
S403
受信レベル≧L1？
NO
YES
S404
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S405A
送信元アドレスを直接転送テーブルに登録
監視タイマスタート
S421A
監視タイマリスタート
S406
受信レベル≧L2？
NO
YES
S407
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S408A
送信元アドレスを直接転送テーブルから削除
監視タイマ停止
S422A
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S423A
監視タイマリスタート
1
2

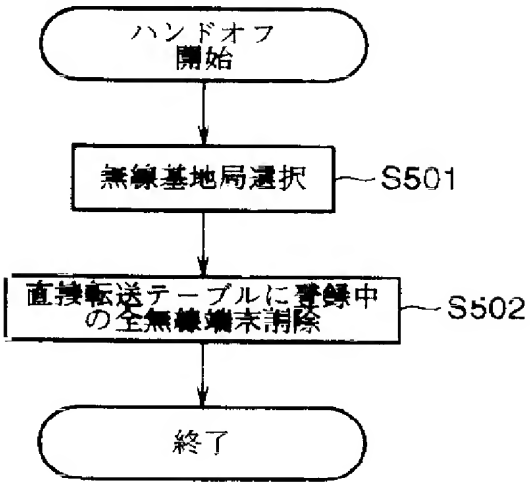
【図１６】


1
2
S409
宛先アドレスが
自局アドレスに一致
？
NO
YES
S410
転送種別 ＝ 01 ？
YES
NO
ACK信号送信
S411
データを上位レイヤへ渡す
S412
終了
廃棄
S413

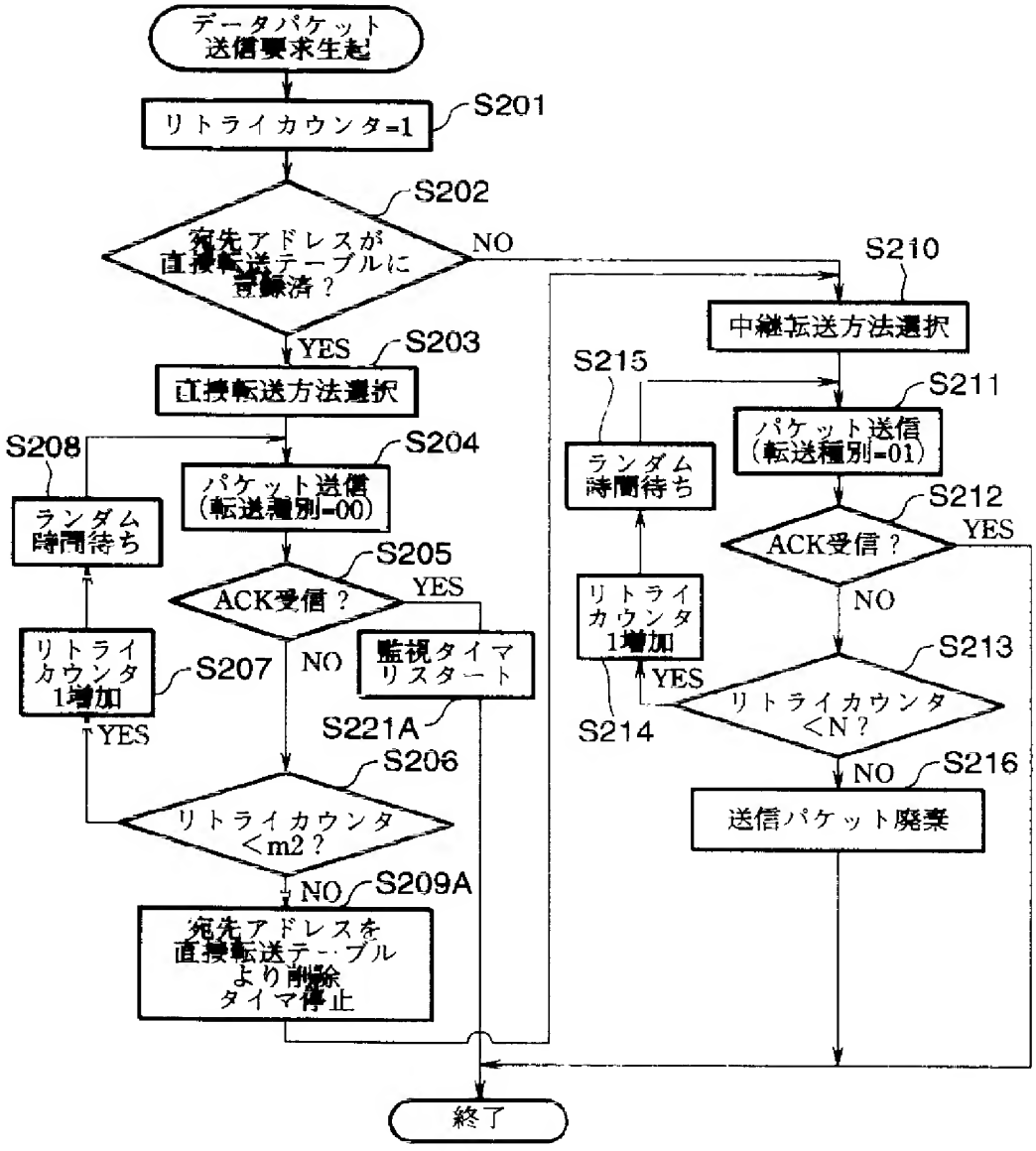
【図３０】


パケット
送信要求生起
リトライカウンタ=1
S201
S202
宛先アドレスが
直接転送テーブルに
登録済？
NO
YES
S231B
パワーセーブ
モード=0？
NO
YES
1
2

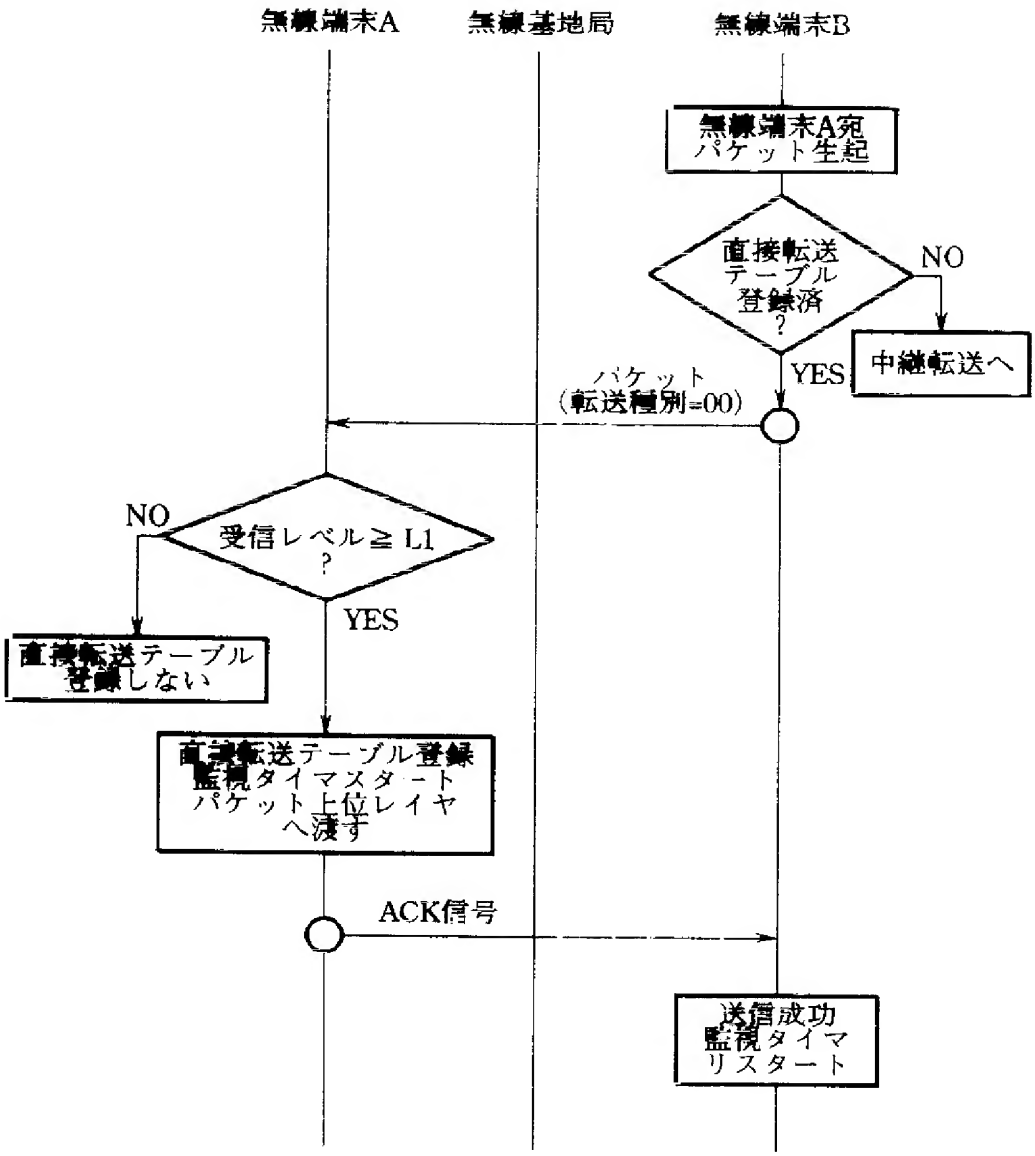
【図４１】


ハンドオフ
開始
無線基地局選択
S501
直接転送テーブルに登録中
の全無線端末削除
S502
終了

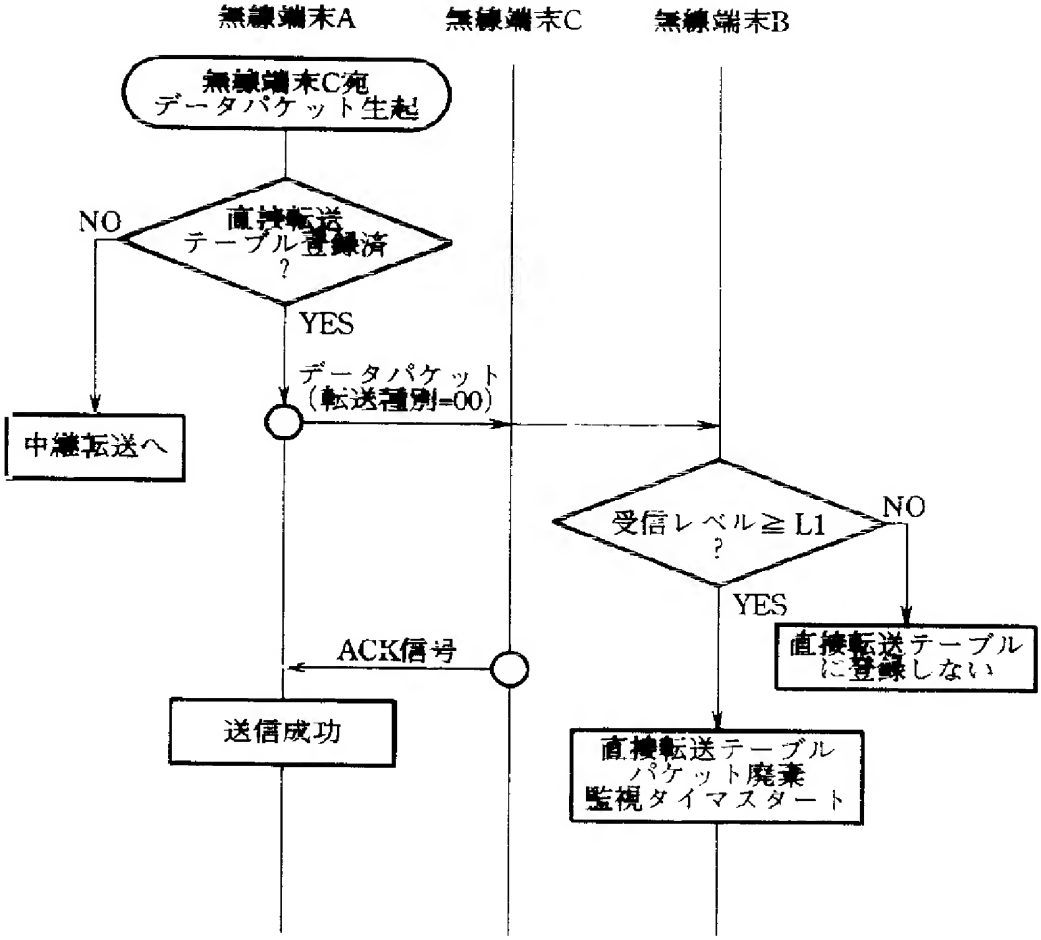
【図１７】


データパケット
送信要求生起
S201
リトライカウンタ=1
S202
宛先アドレスが
直接転送テーブルに
登録済？
NO
YES
S203
直接転送方法選択
S204
パケット送信
(転送種別=00)
S205
ACK受信？
YES
NO
監視タイマ
リスタート
S221A
S206
リトライカウンタ
<m2？
NO
S209A
宛先アドレスを
直接転送テーブル
より削除
タイマ停止
S207
リトライ
カウンタ
1増加
YES
S208
ランダム
時間待ち
S210
中継転送方法選択
S211
パケット送信
(転送種別=01)
S212
ACK受信？
YES
NO
S213
リトライカウンタ
<N？
YES
NO
S214
リトライ
カウンタ
1増加
S215
ランダム
時間待ち
S216
送信パケット廃棄
終了

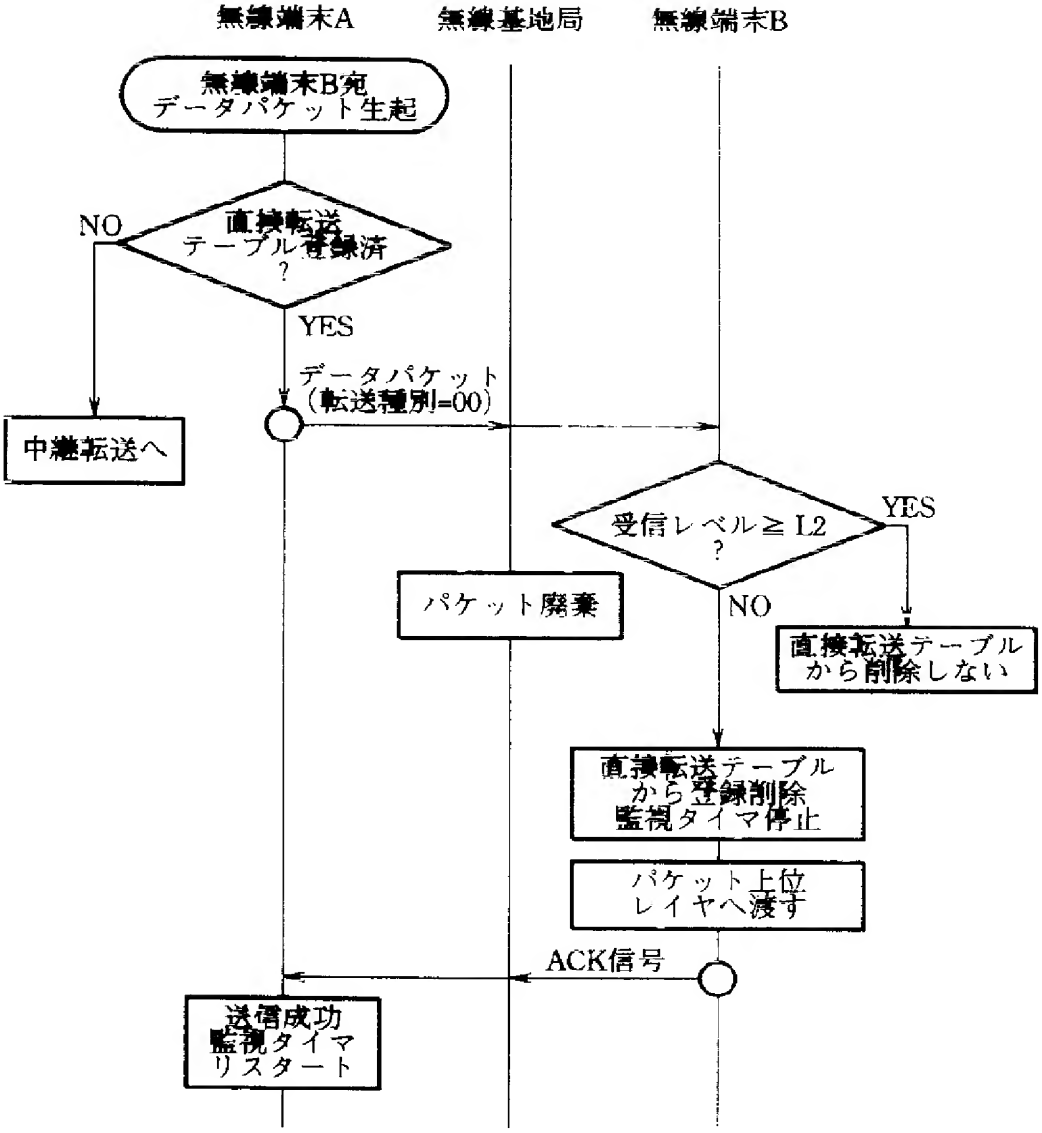
【図１９】


無線端末A
無線基地局
無線端末B
無線端末A宛
パケット生起
直接転送
テーブル
登録済
?
NO
中継転送へ
YES
パケット
(転送種別=00)
NO
受信レベル≧ L1
?
YES
直接転送テーブル
登録しない
直接転送テーブル登録
監視タイマスタート
パケット上位レイヤ
へ渡す
ACK信号
送信成功
監視タイマ
リスタート

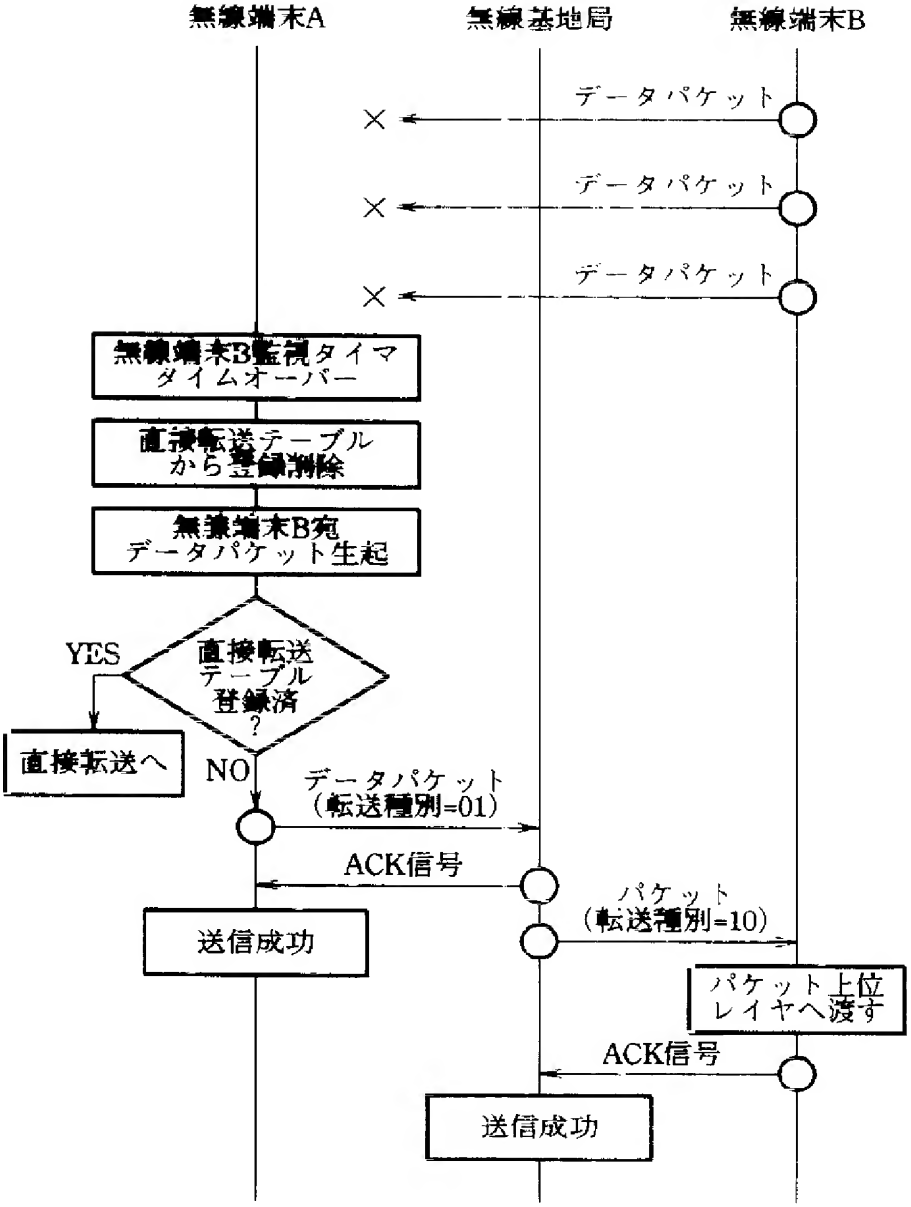
【図２０】


無線端末A
無線端末C
無線端末B
無線端末C宛
データパケット生起
直接転送
テーブル登録済
?
NO
YES
データパケット
(転送種別=00)
中継転送へ
受信レベル≧L1
?
NO
YES
直接転送テーブル
に登録しない
ACK信号
送信成功
直接転送テーブル
パケット廃棄
監視タイマスタート

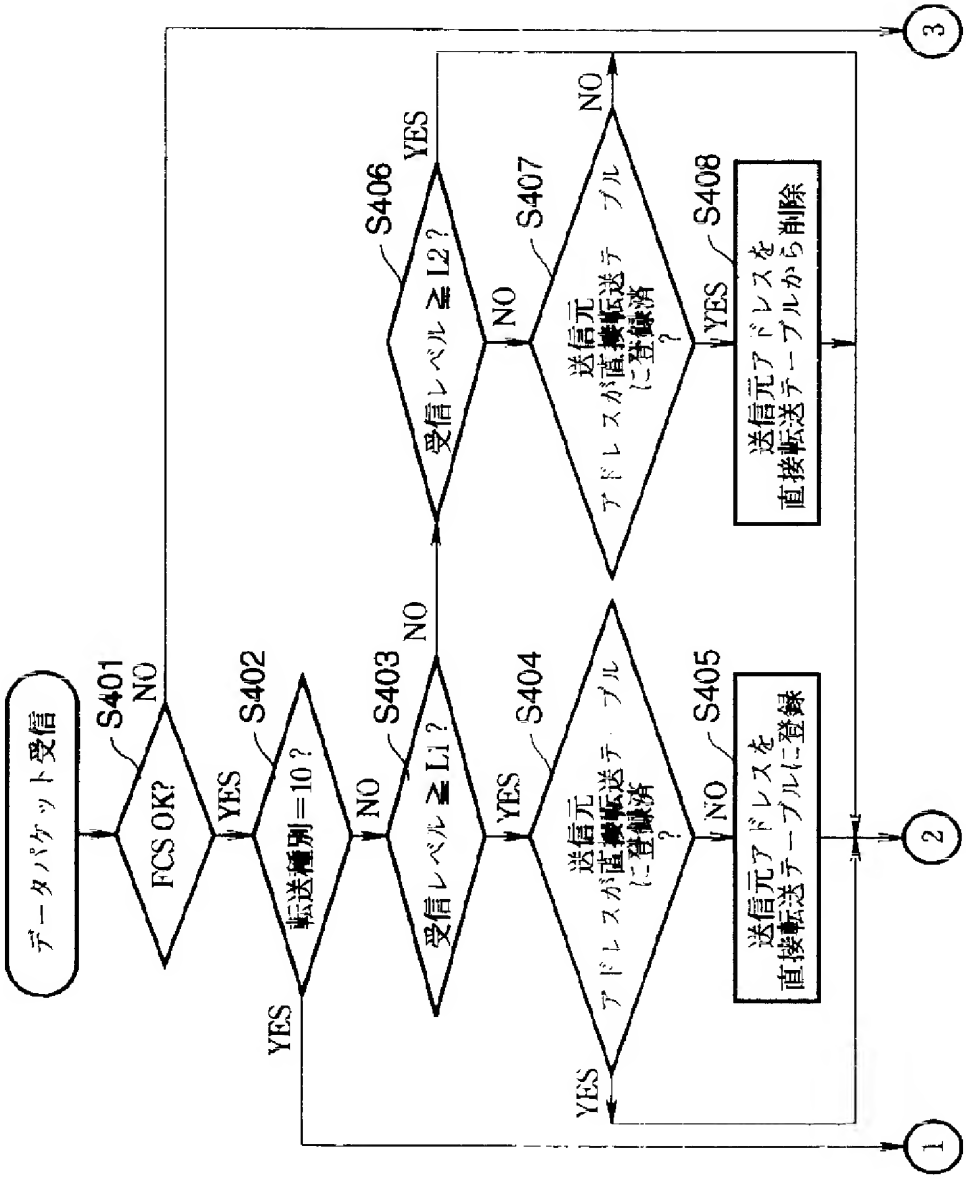
【図２１】


無線端末A
無線基地局
無線端末B
無線端末B宛
データパケット生起
NO
直接転送
テーブル登録済
?
YES
データパケット
(転送種別=00)
中継転送へ
受信レベル≧L2
?
YES
NO
パケット廃棄
直接転送テーブル
から削除しない
直接転送テーブル
から登録削除
監視タイマ停止
パケット上位
レイヤへ渡す
ACK信号
送信成功
監視タイマ
リスタート

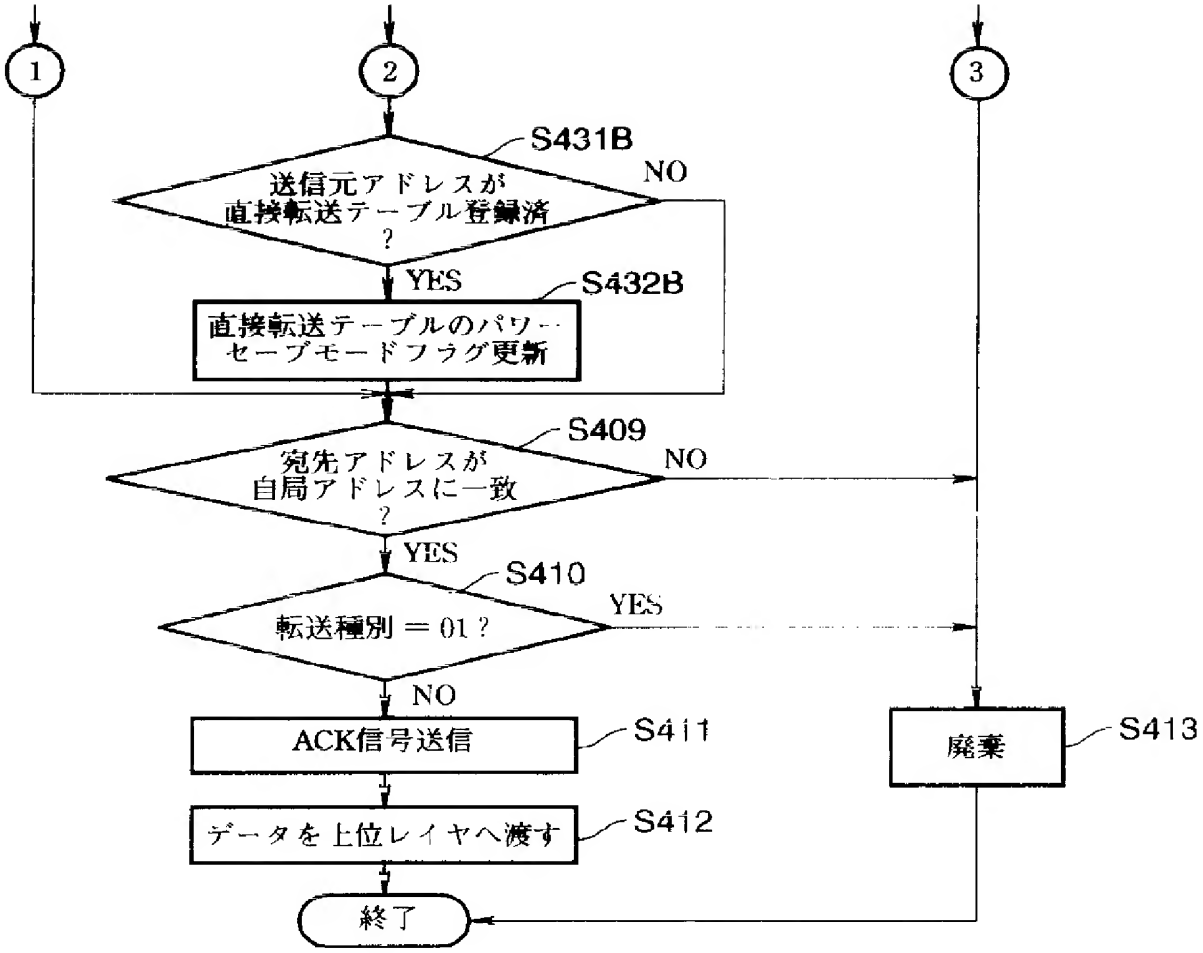
【図２２】


無線端末A
無線基地局
無線端末B
データパケット
データパケット
データパケット
無線端末B監視タイマ
タイムオーバー
直接転送テーブル
から登録削除
無線端末B宛
データパケット生起
YES
直接転送
テーブル
登録済
?
直接転送へ
NO
データパケット
(転送種別=01)
ACK信号
パケット
(転送種別=10)
送信成功
パケット上位
レイヤへ渡す
ACK信号
送信成功

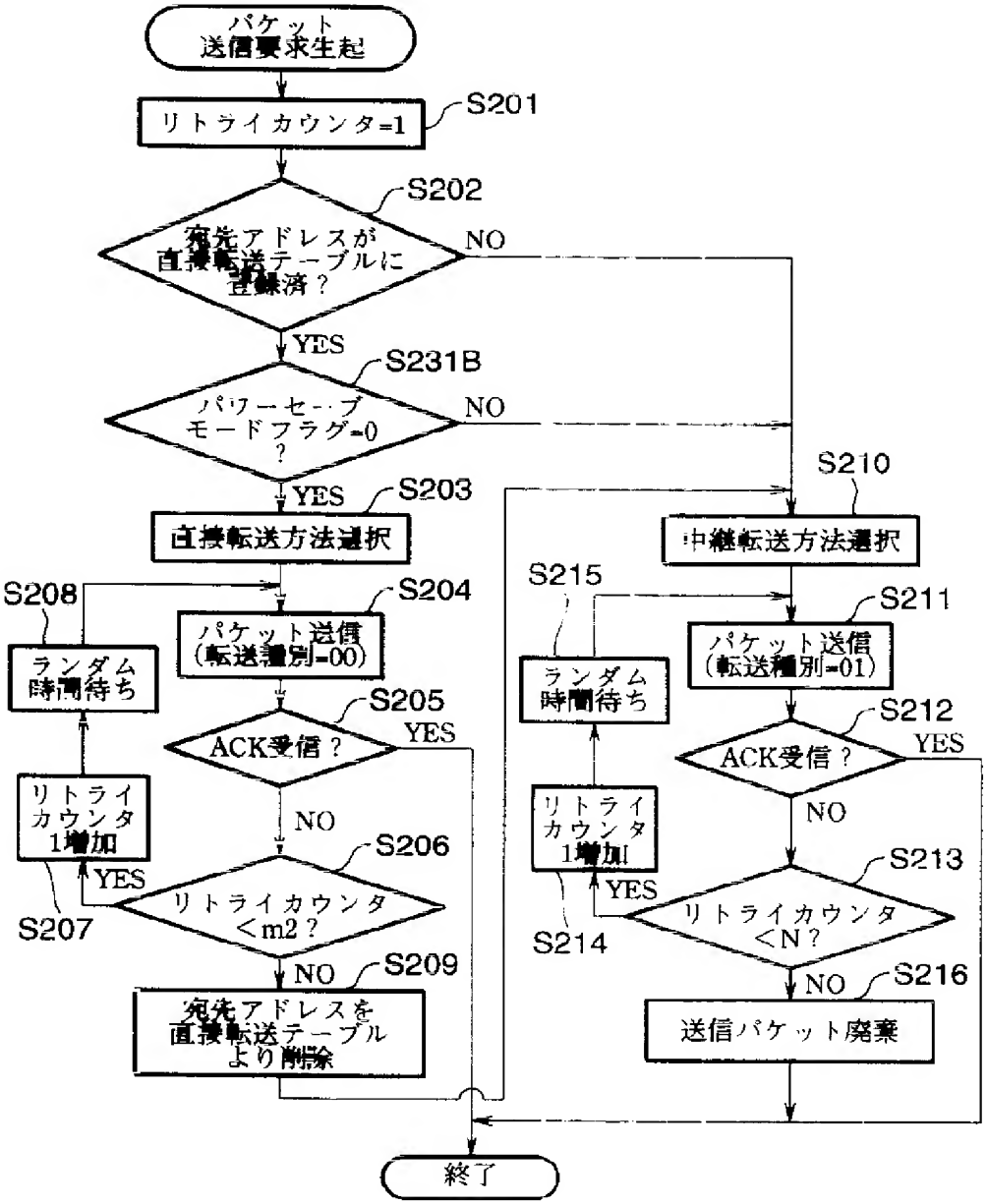
【図２５】


データパケット受信
S401
FCS OK?
NO
YES
S402
転送種別＝10？
NO
YES
S403
受信レベル≧L1？
NO
YES
S404
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S405
送信元アドレスを直接転送テーブルに登録
S406
受信レベル≧L2？
NO
YES
S407
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S408
送信元アドレスを直接転送テーブルから削除
1
2
3

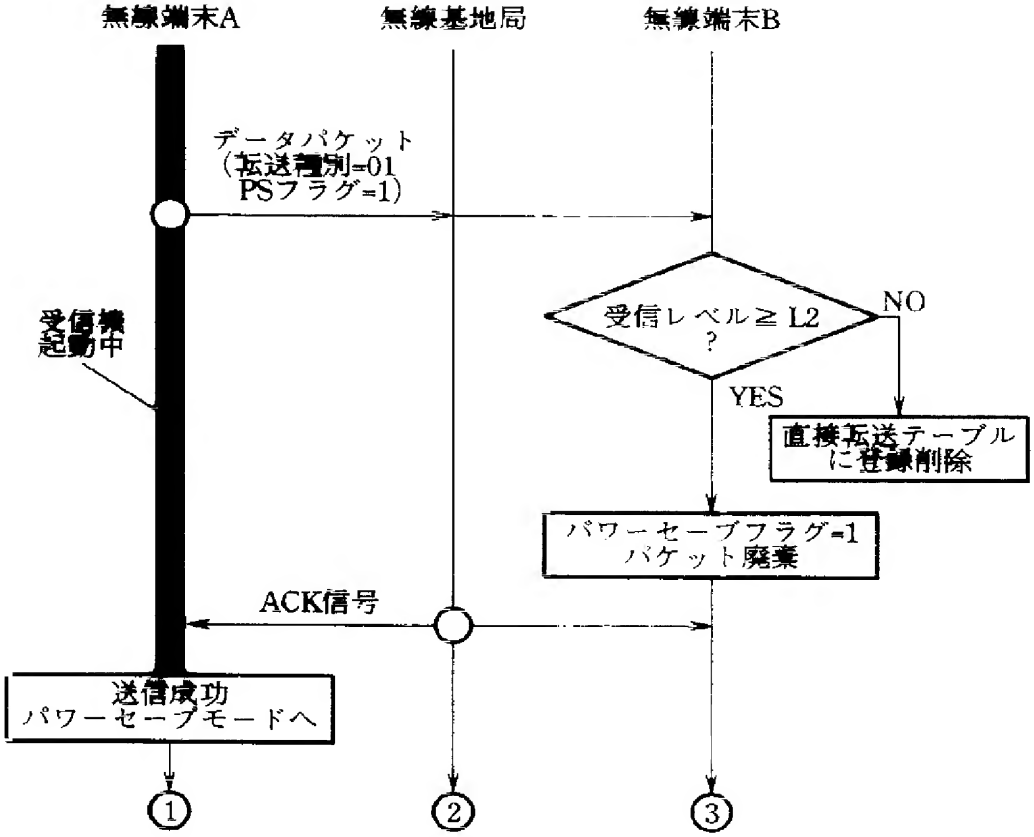
【図２６】


1
2
3
S431B
送信元アドレスが
直接転送テーブル登録済
？
NO
YES
S432B
直接転送テーブルのパワー
セーブモードフラグ更新
S409
宛先アドレスが
自局アドレスに一致
？
NO
YES
S410
転送種別 ＝ 01？
YES
NO
ACK信号送信
S411
データを上位レイヤへ渡す
S412
廃棄
S413
終了

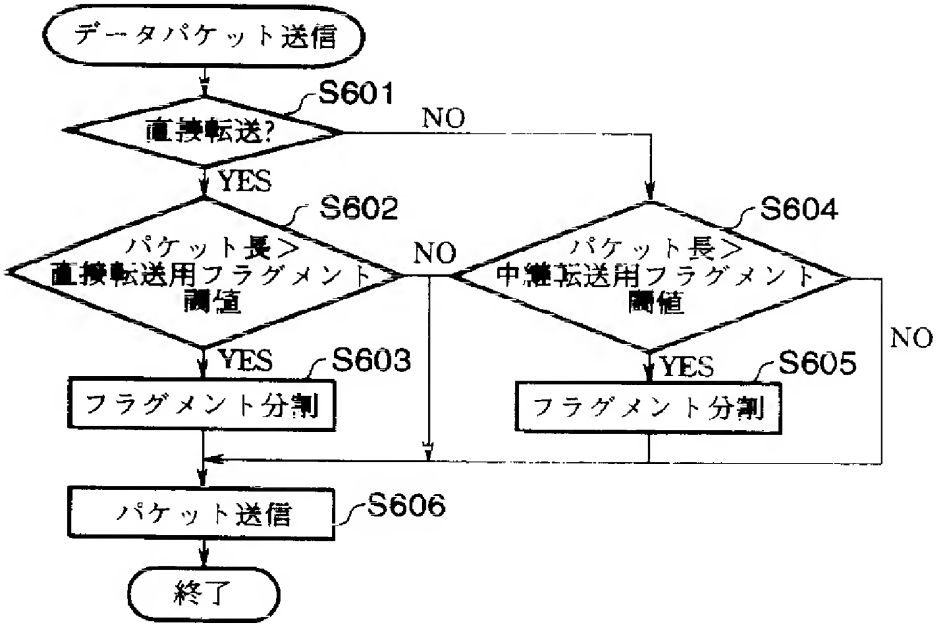
【図２７】


パケット
送信要求生起
S201
リトライカウンタ=1
S202
宛先アドレスが
直接転送テーブルに
登録済？
NO
YES
S231B
パワーセーブ
モードフラグ=0
？
NO
YES
S203
直接転送方法選択
S204
パケット送信
（転送種別=00）
S205
ACK受信？
YES
NO
S206
リトライカウンタ
＜m2？
YES
S207
リトライ
カウンタ
1増加
S208
ランダム
時間待ち
NO
S209
宛先アドレスを
直接転送テーブル
より削除
S210
中継転送方法選択
S211
パケット送信
（転送種別=01）
S212
ACK受信？
YES
NO
S213
リトライカウンタ
＜N？
YES
S214
リトライ
カウンタ
1増加
S215
ランダム
時間待ち
NO
S216
送信パケット廃棄
終了

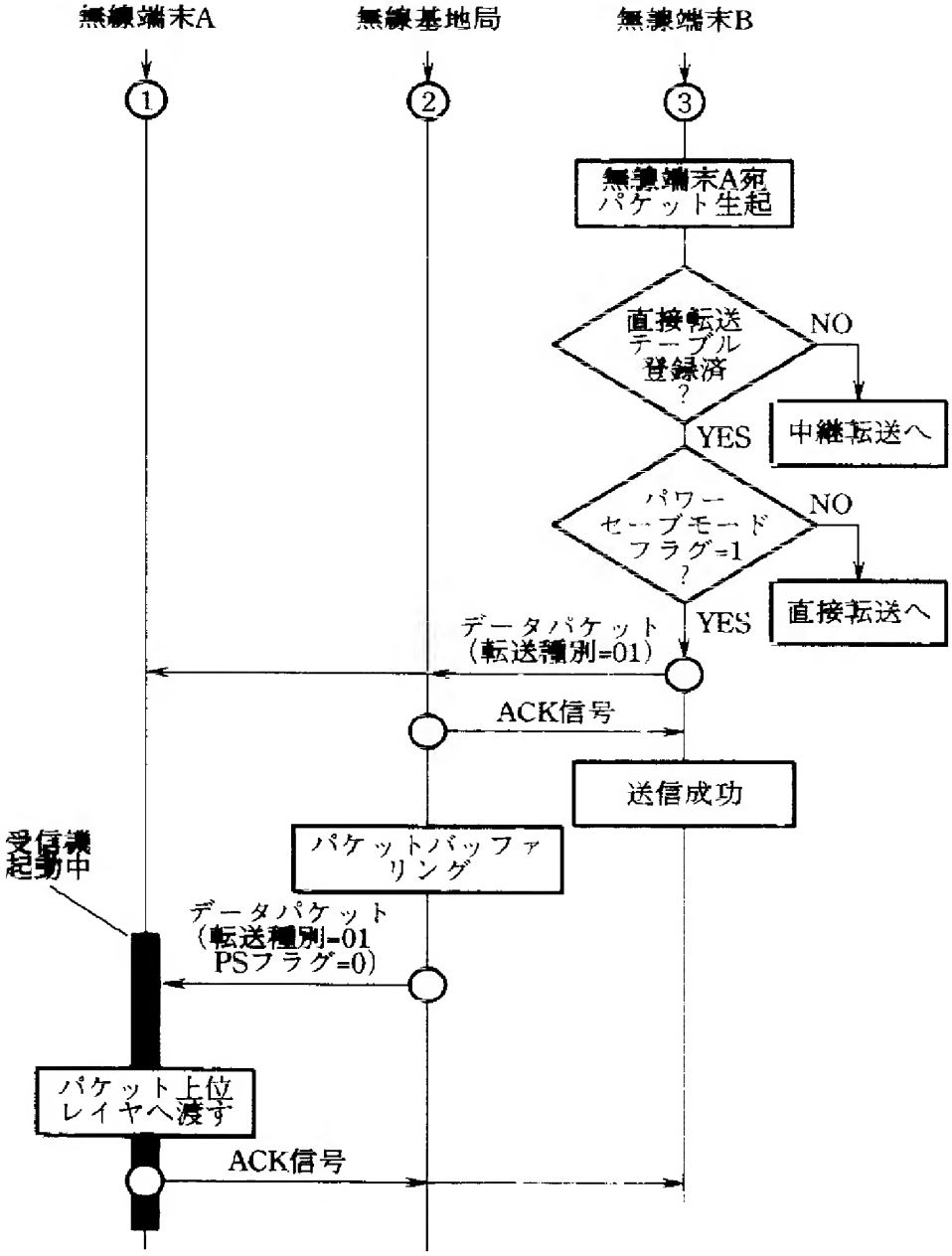
【図２８】


無線端末A
無線基地局
無線端末B
データパケット
(転送種別=01
PSフラグ=1)
受信機
起動中
受信レベル≧L2
?
NO
YES
直接転送テーブル
に登録削除
パワーセーブフラグ=1
パケット廃棄
ACK信号
送信成功
パワーセーブモードへ
①
②
③

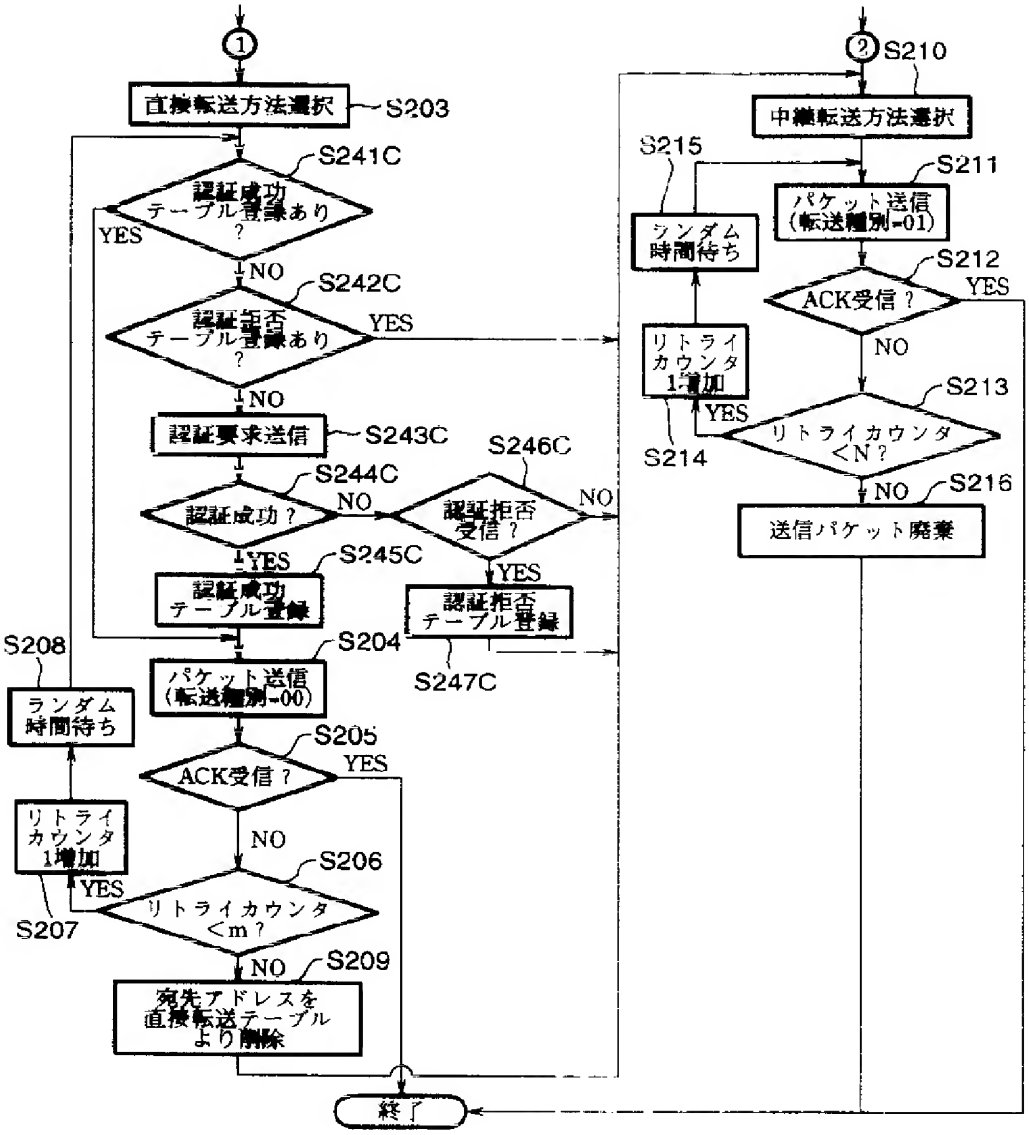
【図４２】


データパケット送信
S601
直接転送?
NO
YES
S602
パケット長>
直接転送用フラグメント
閾値
NO
S604
パケット長>
中継転送用フラグメント
閾値
NO
YES
S603
フラグメント分割
YES
S605
フラグメント分割
パケット送信
S606
終了

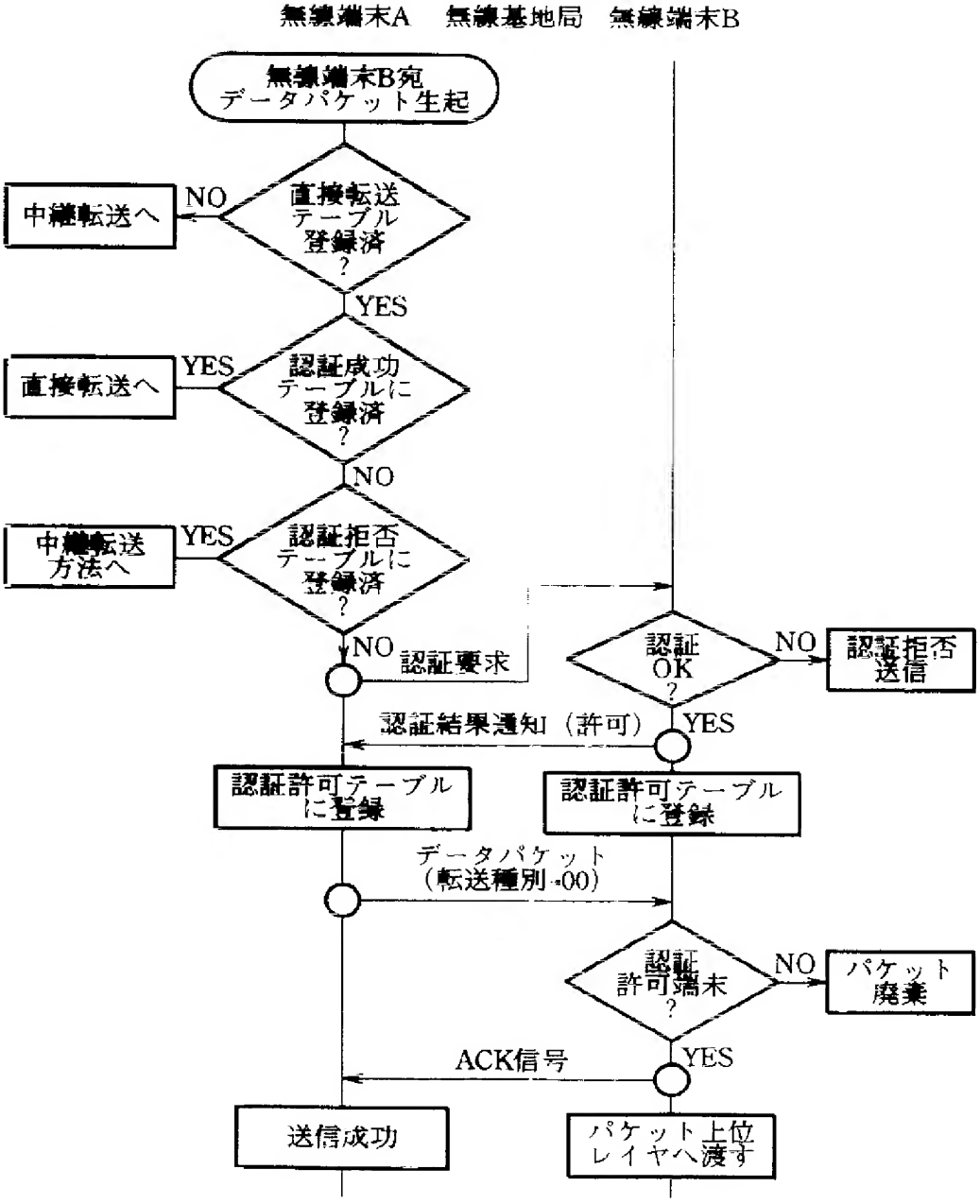
【図２９】


無線端末A
無線基地局
無線端末B
①
②
③
無線端末A宛
パケット生起
直接転送
テーブル
登録済
？
NO
中継転送へ
YES
パワー
セーブモード
フラグ=1
？
NO
直接転送へ
YES
データパケット
（転送種別=01）
ACK信号
送信成功
パケットバッファ
リング
受信機
起動中
データパケット
（転送種別=01
PSフラグ=0）
パケット上位
レイヤへ渡す
ACK信号

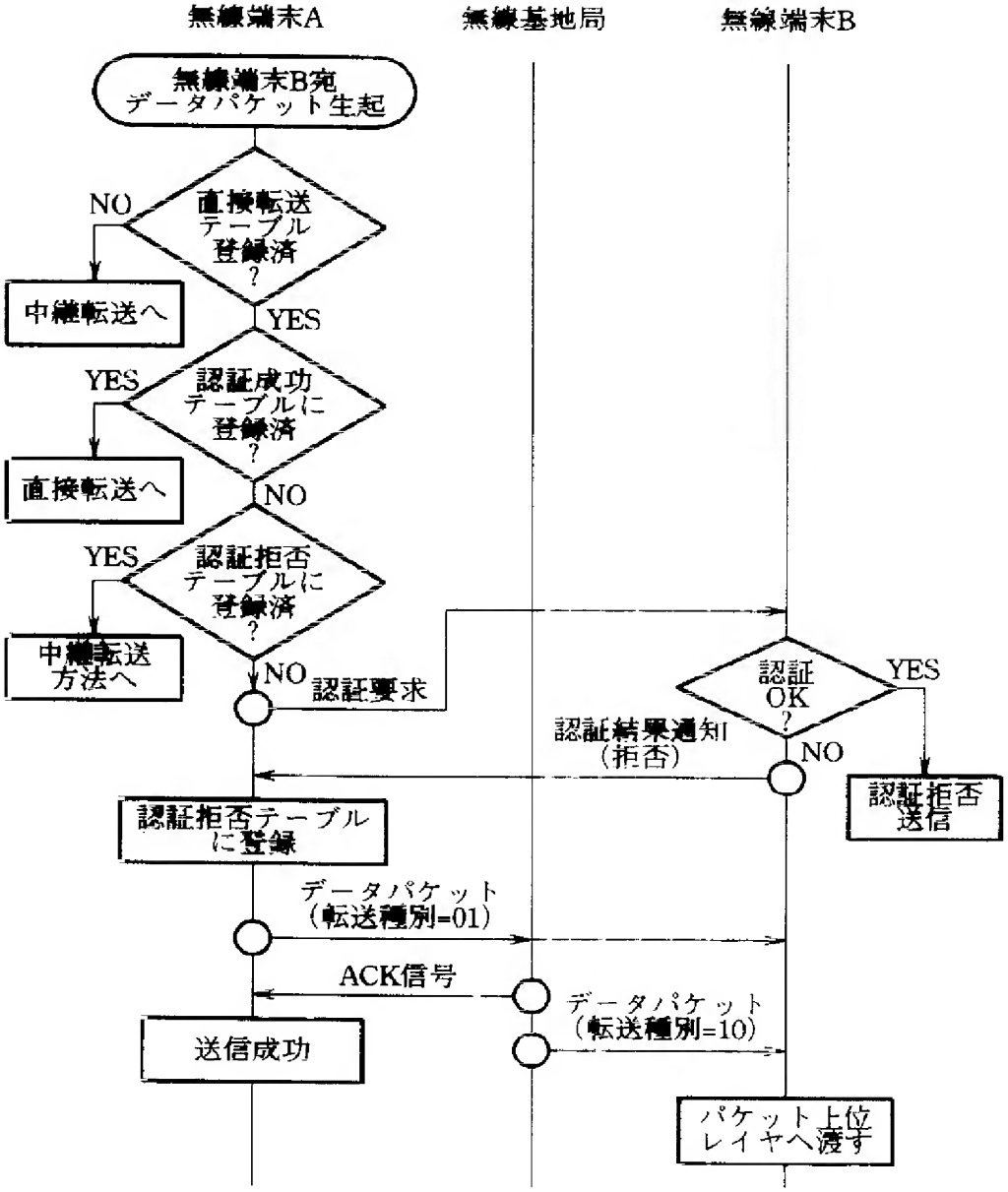
【図３１】


①
直接転送方法選択
S203
S241C
認証成功テーブル登録あり？
YES
NO
S242C
認証拒否テーブル登録あり？
YES
NO
認証要求送信
S243C
S244C
認証成功？
NO
YES
S245C
認証成功テーブル登録
S246C
認証拒否受信？
NO
YES
認証拒否テーブル登録
S247C
S208
ランダム時間待ち
S204
パケット送信（転送種別=00）
S205
ACK受信？
YES
NO
S206
リトライカウンタ＜m？
YES
NO
S207
リトライカウンタ1増加
S209
宛先アドレスを直接転送テーブルより削除
終了
②
S210
中継転送方法選択
S215
ランダム時間待ち
S211
パケット送信（転送種別=01）
S212
ACK受信？
YES
NO
S213
リトライカウンタ＜N？
YES
NO
S214
リトライカウンタ1増加
S216
送信パケット廃棄

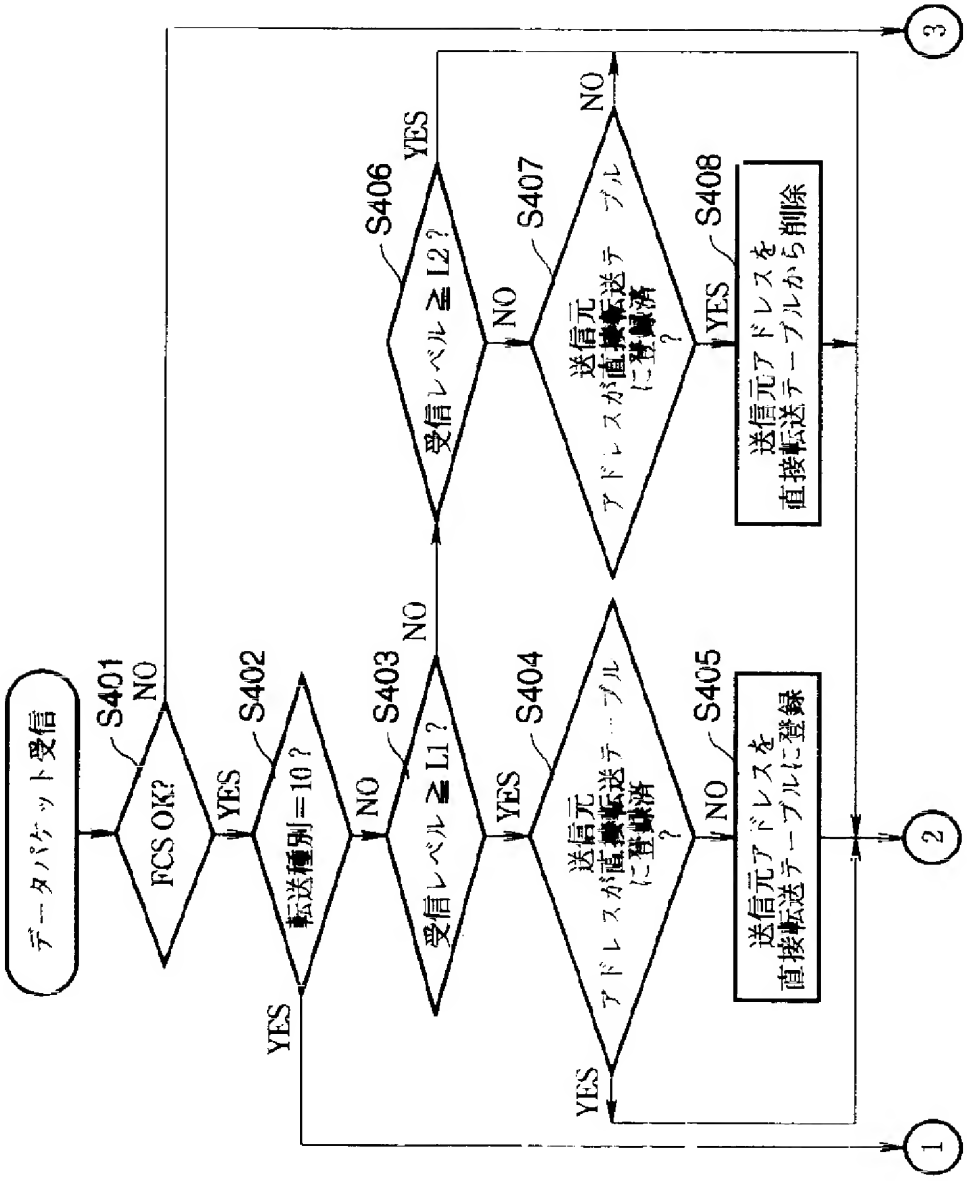
【図３２】


無線端末A
無線基地局
無線端末B
無線端末B宛
データパケット生起
直接転送
テーブル
登録済
?
NO
中継転送へ
YES
認証成功
テーブルに
登録済
?
YES
直接転送へ
NO
認証拒否
テーブルに
登録済
?
YES
中継転送
方法へ
NO
認証要求
認証
OK
?
NO
認証拒否
送信
認証結果通知（許可）
YES
認証許可テーブル
に登録
認証許可テーブル
に登録
データパケット
（転送種別=00）
認証
許可端末
?
NO
パケット
廃棄
ACK信号
YES
送信成功
パケット上位
レイヤへ渡す

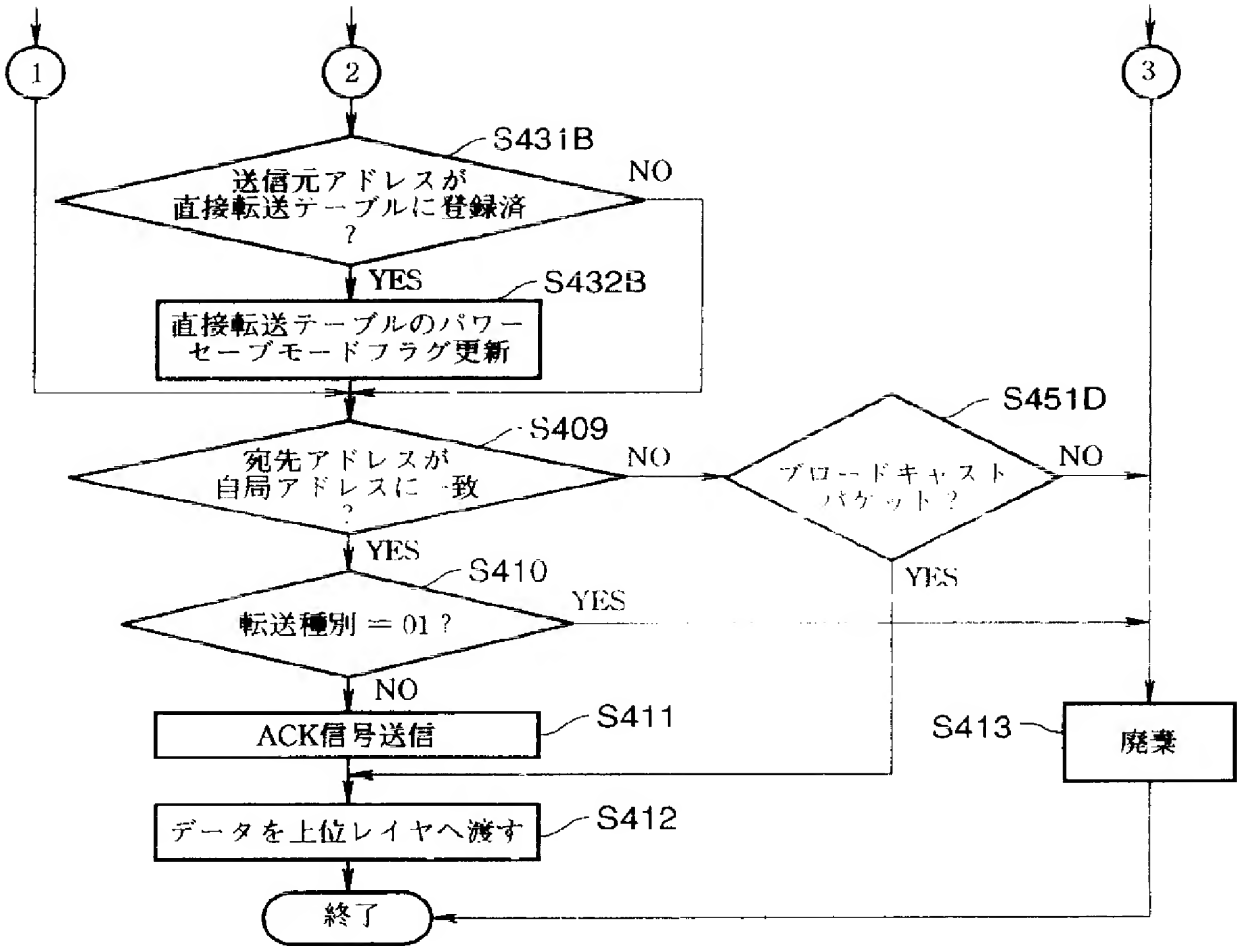
【図３３】


無線端末A
無線基地局
無線端末B
無線端末B宛
データパケット生起
直接転送
テーブル
登録済
?
NO
YES
中継転送へ
認証成功
テーブルに
登録済
?
YES
NO
直接転送へ
認証拒否
テーブルに
登録済
?
YES
NO
中継転送
方法へ
認証要求
認証
OK
?
YES
NO
認証結果通知
(拒否)
認証拒否
送信
認証拒否テーブル
に登録
データパケット
(転送種別=01)
ACK信号
データパケット
(転送種別=10)
送信成功
パケット上位
レイヤへ渡す

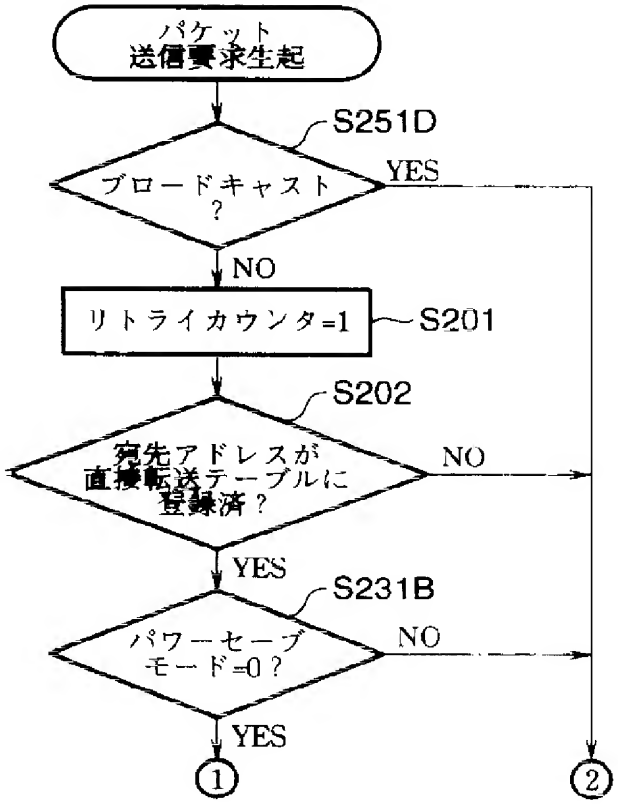
【図３４】


データパケット受信
S401
FCS OK?
NO
YES
S402
転送種別＝10？
NO
YES
S403
受信レベル≧L1？
NO
YES
S404
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S405
送信元アドレスを直接転送テーブルに登録
S406
受信レベル≧L2？
NO
YES
S407
送信元アドレスが直接転送テーブルに登録済？
NO
YES
S408
送信元アドレスを直接転送テーブルから削除
1
2
3

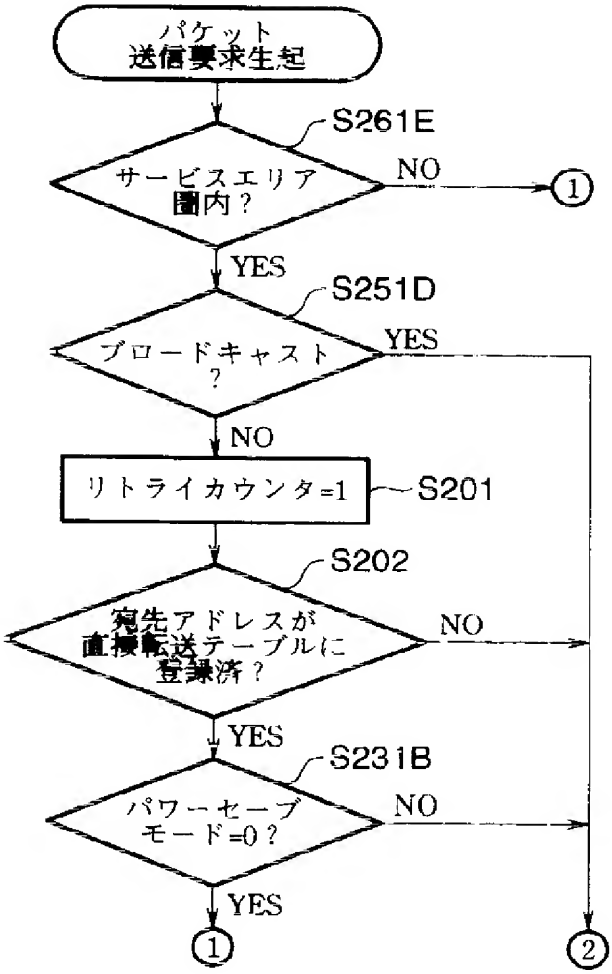
【図３５】


1
2
3
S431B
送信元アドレスが
直接転送テーブルに登録済
？
NO
YES
S432B
直接転送テーブルのパワー
セーブモードフラグ更新
S409
宛先アドレスが
自局アドレスに一致
？
NO
YES
S451D
ブロードキャスト
パケット？
NO
YES
S410
転送種別＝01？
YES
NO
ACK信号送信
S411
S413
廃棄
データを上位レイヤへ渡す
S412
終了

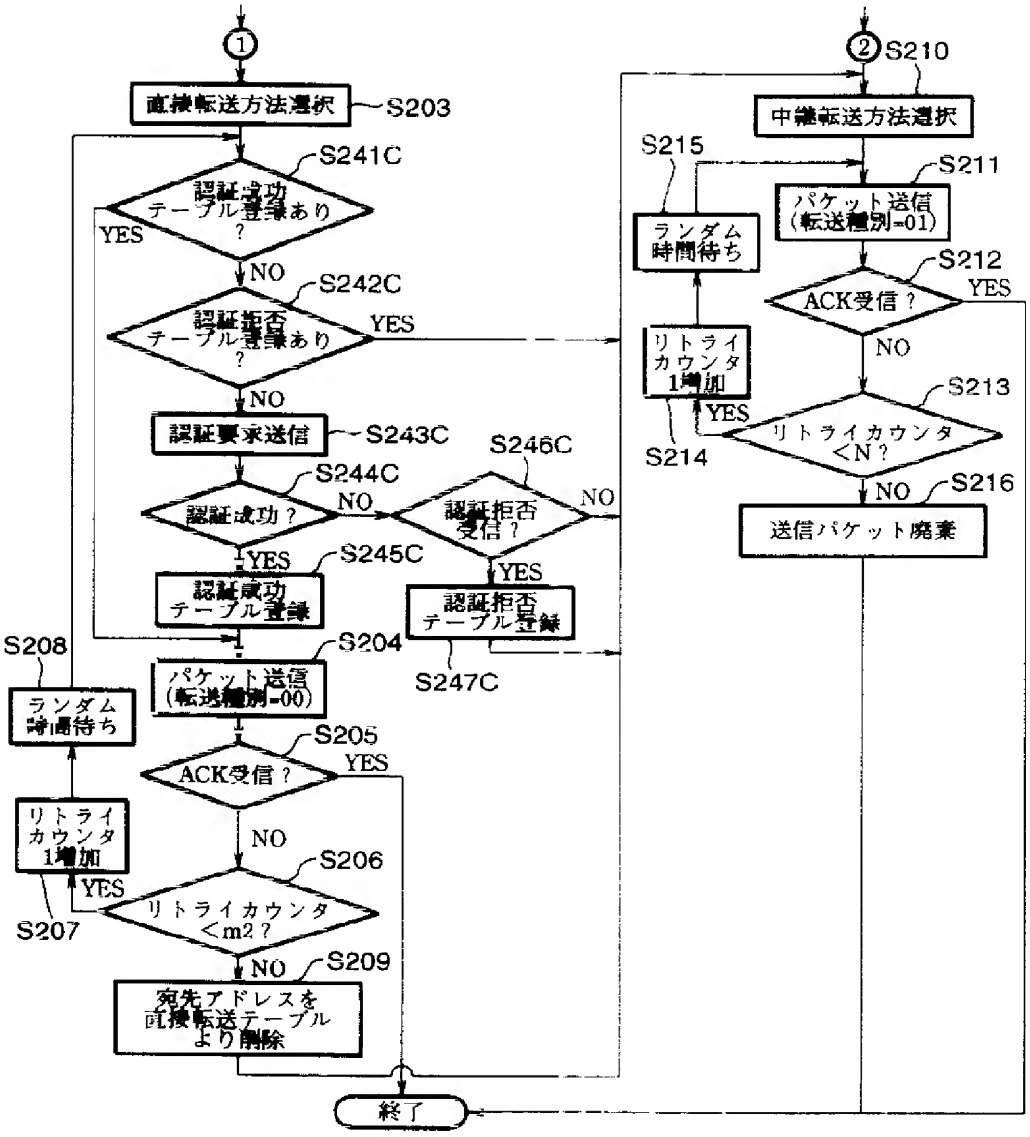
【図３６】


パケット
送信要求生起
S251D
ブロードキャスト
？
YES
NO
リトライカウンタ=1
S201
S202
宛先アドレスが
直接転送テーブルに
登録済？
NO
YES
S231B
パワーセーブ
モード=0？
NO
YES
①
②

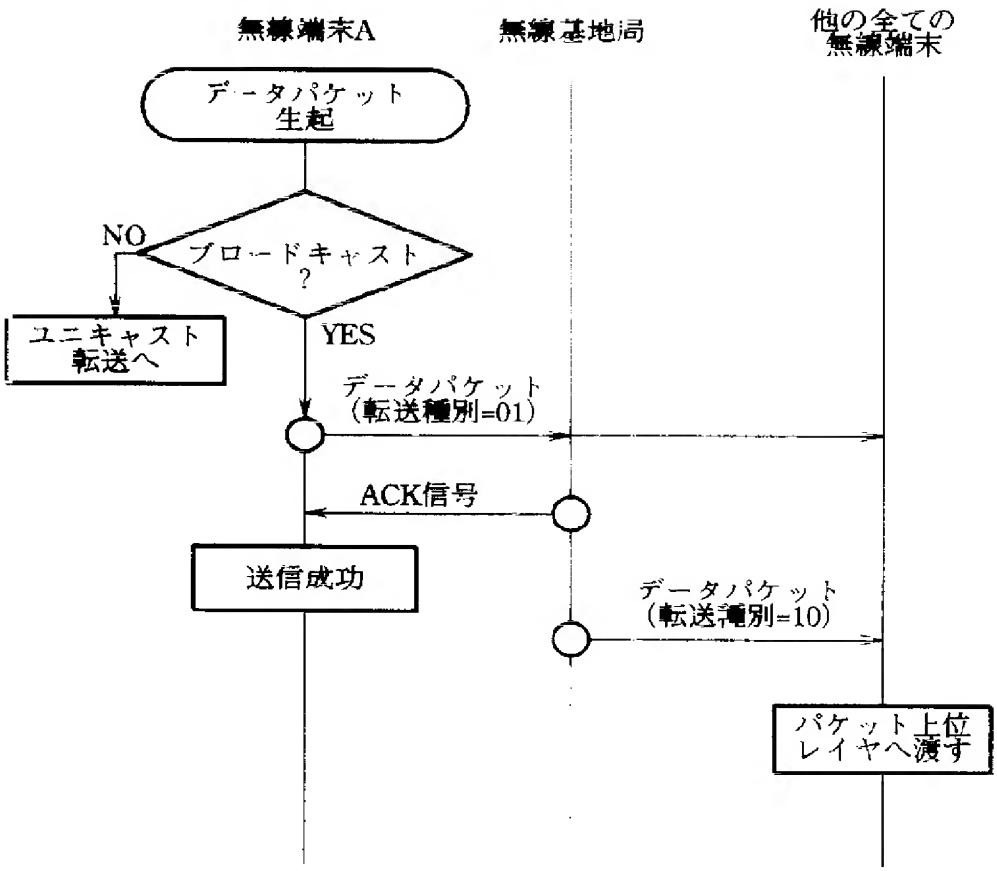
【図３９】


パケット
送信要求生起
S261E
サービスエリア
圏内？
NO
①
YES
S251D
ブロードキャスト
？
YES
NO
リトライカウンタ=1
S201
S202
宛先アドレスが
直接転送テーブルに
登録済？
NO
YES
S231B
パワーセーブ
モード=0？
NO
YES
①
②

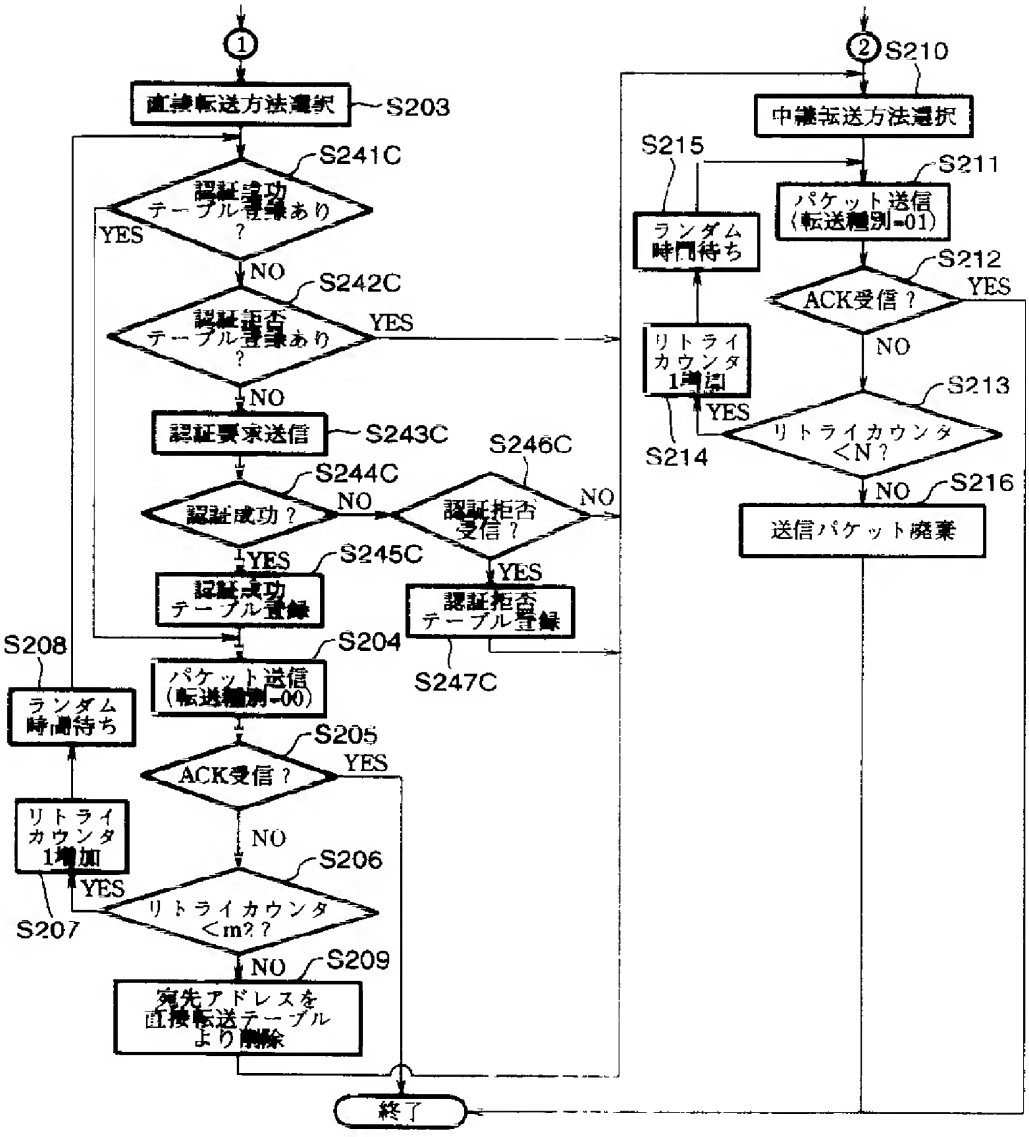
【図３７】


①
直接転送方法選択
S203
S241C
認証成功テーブル登録あり？
YES
NO
S242C
認証拒否テーブル登録あり？
YES
NO
認証要求送信
S243C
S244C
認証成功？
NO
YES
S245C
認証成功テーブル登録
S246C
認証拒否受信？
NO
YES
認証拒否テーブル登録
S247C
S208
ランダム時間待ち
S204
パケット送信（転送種別=00）
S205
ACK受信？
YES
NO
S206
リトライカウンタ＜m2？
YES
NO
S207
リトライカウンタ1増加
S209
宛先アドレスを直接転送テーブルより削除
終了
②
S210
中継転送方法選択
S215
ランダム時間待ち
S211
パケット送信（転送種別=01）
S212
ACK受信？
YES
NO
S213
リトライカウンタ＜N？
YES
NO
S214
リトライカウンタ1増加
S216
送信パケット廃棄

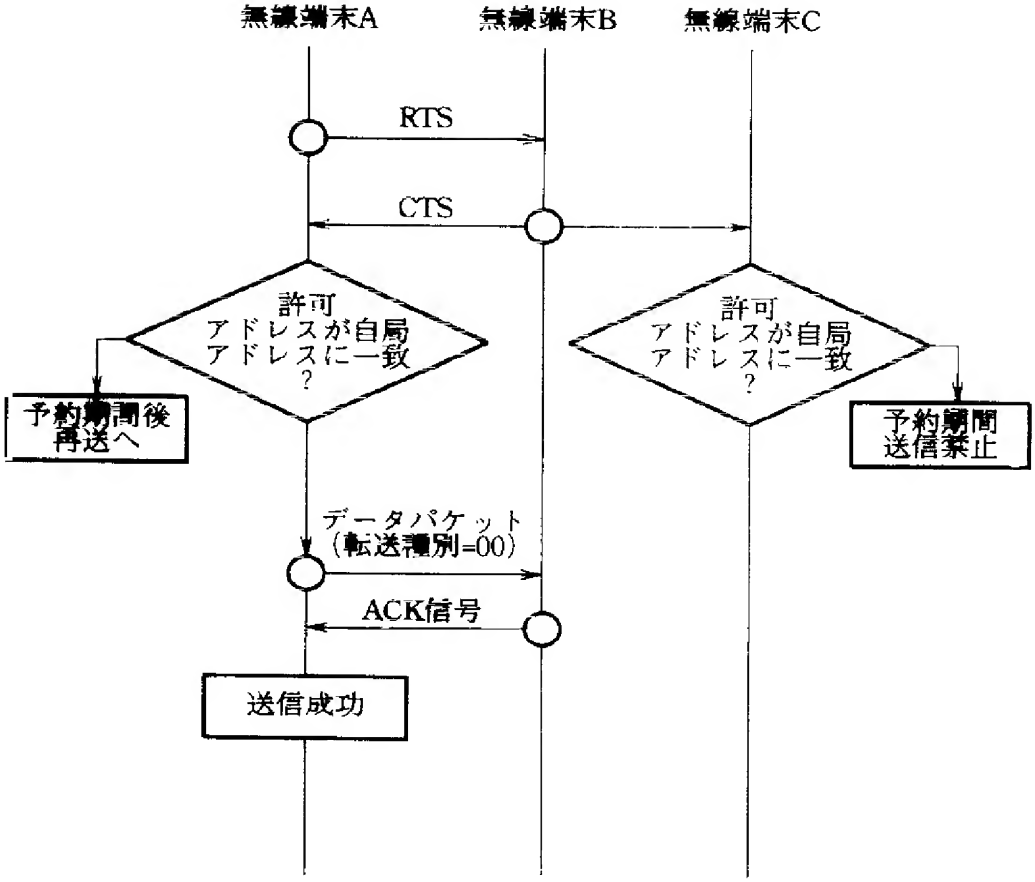
【図３８】


無線端末A
無線基地局
他の全ての
無線端末
データパケット
生起
NO
ブロードキャスト
?
YES
ユニキャスト
転送へ
データパケット
(転送種別=01)
ACK信号
送信成功
データパケット
(転送種別=10)
パケット上位
レイヤへ渡す

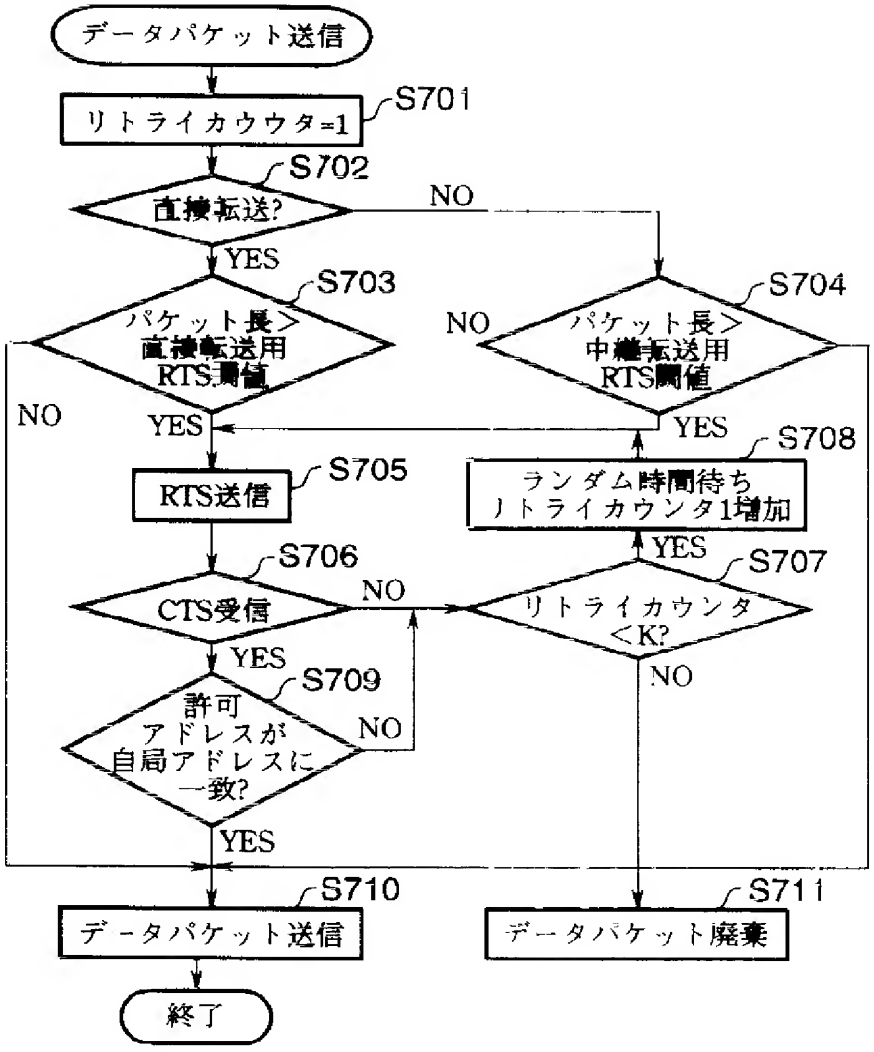
【図４０】


①
直接転送方法選択
S203
S241C
認証成功
テーブル登録あり
？
YES
NO
S242C
認証拒否
テーブル登録あり
？
YES
NO
認証要求送信
S243C
S244C
認証成功？
NO
YES
S245C
認証成功
テーブル登録
S246C
認証拒否
受信？
NO
YES
認証拒否
テーブル登録
S247C
S208
ランダム
時間待ち
S204
パケット送信
（転送種別=00）
S205
ACK受信？
YES
NO
リトライ
カウンタ
1増加
S207
S206
リトライカウンタ
＜m？？
YES
NO
S209
宛先アドレスを
直接転送テーブル
より削除
終了
②
S210
中継転送方法選択
S215
ランダム
時間待ち
S211
パケット送信
（転送種別=01）
S212
ACK受信？
YES
NO
リトライ
カウンタ
1増加
S214
S213
リトライカウンタ
＜N？
YES
NO
S216
送信パケット廃棄

【図４３】


無線端末A
無線端末B
無線端末C
RTS
CTS
許可
アドレスが自局
アドレスに一致
?
許可
アドレスが自局
アドレスに一致
?
予約期間後
再送へ
予約期間
送信禁止
データパケット
(転送種別=00)
ACK信号
送信成功

【図４４】



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